

MEDICAL *J. Brown*
Col's Edin.
ESSAYS AND OBSERVATIONS,
Amwick

WITH DISQUISITIONS RELATING TO

THE NERVOUS SYSTEM.

By JAMES JOHNSTONE, M.D.
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1609/340.
Simplex Sigillum Veri. — Boerhaave.

AND,

AN ESSAY
ON MINERAL POISONS,

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OF MERTON-COLLEGE, OXFORD; FEL. OF THE ROYAL MED. SOC. EDIN. COR.
MEM. OF THE MED. SOC. LON. AND LATE PHYS. TO THE GEN. INFIR. WORC.

EVESHAM:

PRINTED AND SOLD BY J. AGG;

T. N. LONGMAN, AND C. DILLY, LONDON; W. CREECH,
EDINBURGH; FLETCHER, OXFORD; J. DEIGHTON,
CAMBRIDGE; PEARSON, BIRMINGHAM; SMART,
AND OTHER BOOKSELLERS, WORCESTER.

1795.



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I.

AN

ESSAY

ON THE

GANGLIONS OF THE NERVES,

SHOWING THEIR USE IN THE VITAL AND OTHER IN-

VOLUNTARY MOTIONS OF ANIMALS.

REPUBLISHED WITH ADDITIONS,

IN

IN experimental philosophy, propositions collected from the phenomena by induction, are to be deemed, notwithstanding contrary hypothesis, either accurately, or very nearly true, till other phenomena occur, by which they may be rendered either more accurate, or liable to exceptions.

*Sir Isaac Newton's fourth rule of Philosophising Pract.
Math.*

THE works of God are so worthy of their author, that beside the impresses of his wisdom and goodness left, as it were, upon their surfaces, there are a great many more curious and excellent tokens and effects of Divine artifice, in the hidden and innermost recesses of them. And these are not to be discovered by the slight glances of the lazy and the ignorant; but require the most attentive and prying inspection of curious and well-qualified minds. — Boyle Chr. Virtuoso.



ADVER-

ADVERTISEMENT.

THE first sketches of this Essay were, many years since, put into the hands of Dr. *Lyttelton*, bishop of Carlisle, and president of the Antiquary Society; who, with all the qualities that endeared the friend and adorned the gentleman, had that affection to learning and science, which has long distinguished his family.

His Lordship presented to the Royal Society that paper, which, with the supplements to it, were first published in the 54th, 57th, and 60th volumes of the Philosophical Transactions. If they appear in this republication,

publication, with any new advantages, they are owing to the connection of materials, and, to the friendly and candid remarks of very distinguished judges of this subject; which, however, appearing insufficient to overturn this doctrine, led me to make such additions, and to try such experiments, as seem to clear up the objections made to it, and illustrate and enforce the conclusion with such preponderance of argument and evidence, as will probably hereafter entitle it to consideration in the physiology of the nerves, and involuntary motions of animals; and may encourage students in anatomy and medicine, to supply my deficiencies, and become improvers of this subject, and in the knowledge of the nervous system at large, which is every where an open and inviting field for the exercise of industry and genius.

No one can be more sensible than I am,
that,

that, with very inadequate qualifications, I have undertaken a most difficult task. The utmost I flatter myself to have done, is to have opened a path, which may be beaten by others, to the instruction of mankind.

Indulging the persuasion, that I have traced an outline of a new branch of physiological and medical science, I submit this Essay again to the public eye; and, now take leave of the subject, in the words of *Seneca*: “Multum adhuc restat operis, multumque restabit; nec ulli nato post mille secula præcludetur occasio aliquid adhuc adjiciendi.”*

*THE additions to this republication of the first Essay, are chiefly in the notes, under p. 4—13—28, and seq. In the text, from p. 30—37; and fifth and sixth Sections.

The papers not before published, and wholly new,

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new, in this volume, are, art. 2—7—8—9—12, and the valuable Essay on Mineral Poisons.

From the industry and genius of the author of this Essay, the learned world has more to expect: provided he restrains the ardour of his pursuits within the bounds required by a delicate constitution.

In estimating the powers and action of different substances employed in medicine, it is highly useful to ascertain the extreme mischiefs they are capable of producing, in order to guard against them.



E R R A T A.

NOTE, p. 5.—for 117 read sect. 7. P. 11.—Devise's—Divises. P. 12. l. 11—Pericardiam—Pericardium. P. 30. l. 46—Saturnian—Saturnine. P. 31. l. 1—Valli—Valli. P. 131. l. 1—Pleuro-pneumies—Pleuropneumonies. P. 114—Canium—Cranium P. 159, 160—read Hyotcyamus lb. l. 12—Deliterious—Deleterious. P. 166 l. 3—read Deprived. P. 224. l. 6—Mental—Rural. P. 226, &c.—Biliose—Bilious. P. 229—T. Sacra—Sacrae. P. 231. l. 17—Pericardium—Peritoneum. P. 168. l. 8—after vinegar: add—and in the intervals an equal quantity of volatile tincture of gualacum in coffee. P. 176—after extinguish life. (see Prosper alpini de medicina aegypt. l. 4. p. 119.) P. 278, l. 3—after Royal, add Medical. p. 234, l. 17—dele period.

AN
E S S A Y
ON THE USE OF THE
GANGLIONS OF THE NERVES.

SECTION. I.

The use of the Ganglions of the nerves not hitherto ascertained: Introductory Propositions concerning the nerves in general.

THE Ganglions of the intercostal, or great Sympathetic Nerves, described by *Fallopious*,* are oblong, and very hard knotty bodies; the uses of which have not been satisfactorily ascertained by any one. From some vague resemblance which anatomists fancied they found in these knots, to those in the roots of some plants and branches of
B trees,

* The word Ganglion, is a Greek root, found in *Celsus* and *Galen*, and preserved in modern books of surgery; it was at first used as the name of certain hard tumors, seated on the ligaments or sinews. The resemblance of the ganglions of the nerves, real or fancied, to these morbid tumors, was probably the occasion of their being called, by *Fallopious*, indiscriminately, Ganglia, as well as corpora olivaria & plexus. These terms, and those of consociation and association, of nerves, were used by succeeding anatomists.

trees, it was supposed their use consisted in giving some additional *firmness* to the nerves: but this has not often been repeated by anatomical writers after *Willis* and *Vieussens*. Few anatomists have, indeed, examined this subject, with that attention and accuracy, with which it is discussed by the learned *J. M. Lancisi*. He imagined the Ganglions to be muscles *sui generis*, and, like other muscles, capable of contractions; by which, he thought, the nervous spirits were accelerated and impelled with such additional forces as are, by him, supposed necessary to the production of motions in muscles subject to the will: and, in order to give an idea of the structure of all other Ganglia, he particularly describes and delineates that of the first cervical Ganglion.*

This theory has the misfortune to be erroneous
in

as synonymous, till about the beginning of this century: that the knots peculiar to certain nerves, I think, for the most part, are now only called Ganglia. The other unions of the nerves, without intumescence or hardness, are called Plexus; and in this distinct sense we shall use these words throughout this Essay.

“Corpora olivaria aliquando concresecunt, incerto tamen numero, quæ
“nulla alia substantia quam nervea & quasi in callum concresecente constant.—
“Cum ego primus talem nervorum copulam observarem, primus quoque
“nomine imposito plexum appellabo a quo plexu plures nervi ad cordis basin
“firm feruntur.” *Fallop. Obs. Anat. edit. cum oper. Vesal. p. 737.* The ingenious Dr. *Martin* concurs with *Vesalius* in diminishing the pretensions of *Fallop* as the first discoverer of the ganglions of the nerves, and in giving that honour to *Galen*, See Comment. in *Eust.* Tab. p. 208.

* See *Lancisi's* Dissertation published in the *Adversaria Anatomica* of *Morgagni*.



GANGLIONS OF THE NERVES. 3

in its foundation; for that most accurate and skilful inquirer into subjects of this nature, the illustrious Baron *Haller*, and other celebrated anatomists, have not been able to discover this muscular apparatus in the *first cervical Ganglion*,* or in any other *Ganglion*. The coverings and substance of ganglia, with the appearance, have all the firmness of ligamentous substance, but are incapable of that extension and contraction which *muscular fibres*, ever *elastic*, always allow of.

Ganglions besides, instead of being instruments subservient to the will, are almost peculiar to nerves, distributed to parts, the motions of which are totally involuntary. And our author must have been greatly misled by his hypothesis not to observe this striking circumstance. The theory, which prevailed in his time and country, of the action of the *dura mater* upon the brain, now exploded, might lead this great man more entirely to believe an analogous muscular power in Ganglions. But the brain needs no muscular force to impress motion upon the animal spirits; *the power presiding there is of a different kind*: nor, granting Ganglions to be, as is ingeniously conjectured by *Lancisi* and *Winslow*, subsidiary brains, or analogous to the brain in their uses, will they need any such muscular apparatus and force. A power, in

B 2

fine,

* *Haller's Elem. Physiol. Human. Tom. iv. p. 203.*

fine, absurd, no less than imaginary, as it supposes the force of muscles of the greatest exertion and effect, to be derived from those of least bulk and strength: (which must, *cæteris paribus*, act in proportion to the quantity of muscular fibres,) and would be a single instance of a mechanical force producing another infinitely greater than itself.

The accurate *Winslow* reckons the Ganglions, especially those of the spinal nerves, to be so many dispersed origins of the great sympathetic nerves; but goes no farther in pointing out their use. The late professor *Monro*, in his excellent treatise upon the nerves, and the illustrious Baron *Haller*, in his great work, in which he gives a complete view of every thing that relates to the physiology of the human body, with most other anatomists, esteem the uses of the Ganglions absolutely unknown.*

Before

* I had made some progress in a history of the anatomy of the brain and nerves, to prove this point; and to shew how limited our knowledge is, and how few the real improvements are, which have added to the stock of knowledge concerning the nervous system, derived from the most ancient anatomists: but finding it impossible to procure the books necessary to this design, I have given it up, at least for the present.

That nothing probable on the uses of the Ganglions of the nerves was before known, will appear by consulting the *Elem. Phys.* of Baron *Haller*. For this purpose I add the following quotation from the anatomy of the nerves of Dr. *Monro*, sen. my first master in anatomy.

“ Some have thought the Ganglions of the nerves to be glandular, and to perform a secretion.— Others, from their firm texture, suppose them to be muscular

Before I proceed to examine into the uses of Ganglia, it will be proper to premise, as first principles, the following propositions concerning the nervous system, which are demonstrated by anatomists and physiologists.

1. The brain consists of a glandular substance of a cineritious colour, and abounding with blood vessels, called its cortical substance: the medullary part of the brain arises from the cineritious, and the nerves from the medullary substance; of which they are prolongations.

B 3

2. Every

muscular, and to serve to accelerate the motions of the liquor in the nerves which proceed from them; but as no proof is offered for either of these opinions, they cannot be maintained.—Others would make them serve, 1. To divide a small nerve into many nerves; and by these means to increase the number of nervous branches. 2. To make nerves come conveniently by different directions to the parts to which they belong. 3. To reunite several small nervous fibres into one large nerve. Since no proof is brought that these three things cannot be done without the interposition of a Ganglion, but, on the contrary, we see them performed, where there are no Ganglions, we must continue to acknowledge ignorance, concerning the uses of these knots the Ganglions."

These sensible observations seem equally subversive of an hypothesis, not very different, of *A. Monro*, the son, published 1783, in his work on the structure and functions of the nervous system, p. 57—117.

"These complications of the nerves being invariably destined for particular parts, this general uniformity in connection and distribution must answer some purpose superior to mere mechanical convenience." This was the opinion of the deceased *J. Hunter*; and so far as respects the Ganglions, is what I prove in this Essay. Whatever defects may be found in it, the reader will recollect, that at the time I began my inquiries, physiology did not so much as hazard a plausible conjecture on the subject.

2. Every nerve is, properly speaking, a bundle of smaller nerves, or cylindrical threads; all of which run parallel to each other, without confusion (except perhaps in Ganglions) from the brain to their terminations; every funicle of which a nerve consists has its membranous coat, continued from the *pia mater*.

3. The funicles, (2) which to the unassisted eye seem single, and to compose a nerve, with the help of a microscope, are found made up of innumerable smaller filaments. From late microscopic observations, the medullary matter appears to assume a spiral appearance, in the course of the nerves: and in the sensory organs and muscles appears like mucus; but must be there curiously organized, in some manner yet undiscovered.

4. These nervous filaments or threads, derived from the medullary part of the brain, convey impressions or sensations to the soul, or sentient principle seated there.

5. Undoubted Experiments demonstrate that the power of voluntary motion is derived from the brain, by the nerves, to the muscles of the part moved. By experiments we endeavour to imitate or illustrate this: thus, if the brain, or any nerve issuing from it, be stimulated by any irritating cause, the parts whose nerves are irritated, whether
in

in the brain, or lower down, will always be convulsed. And ligatures upon nerves, with no less certainty intercept the efficacy of this irritation above them, than they render the parts paralytic or immoveable by the will.

6. But this power or cause which is conveyed by nerves, and puts muscles in action, is not instantly lost in nerves, when their communication with the brain is interrupted by cutting the nerve asunder, or tying a tight ligature upon it. For if the nerve be irritated below, or betwixt the section or the ligature, and the muscle it goes to, the muscle is convulsed as effectually as if the communication with the brain had not been cut off. Thus, after the head is cut off, irritations of the spinal marrow convulse the trunk of the body and limbs entirely: in like manner irritations of particular nerves, the *phrenic* for example, after the destruction of the spinal marrow, throw the diaphragm into convulsive contractions: thus the muscles of the head, eyes, and tongue are convulsed by probes thrust into the brain, when the head is separated from the body: and thus the heart itself is made to contract, after it is separated from the body. So that it is evident, that, though in a general view and ultimately, the nerves and muscles depend upon the brain for their fluid, or whatever is the cause of their energy; yet that dependance is by no means so immediate, but that effects may be

produced by and in nerves and muscles separated from the brain, through that remaining stock of energy sometime before derived from it, and not so suddenly dissipated and exhausted as some theories would incline us to believe.

Hence also we may conclude, that it is not certain that irritability, is so entirely a distinct property of muscular fibres, as to be totally independent of the nerves; as no experiment can be contrived, in which muscular fibres can be perfectly separated from the nervous web, intermixed with, and diffused among them; and to which the contraction of muscles irritated after separation from the body, may be owing in a great measure.

S E C T. II.

Seat and genuine use of Ganglions.

1. **G**ANGLIONS are observed to be seated generally upon nervous cords, formed by the union of several different nerves; and sometimes too before nervous cords send off branches.

All of them, except the ophthalmic Ganglion, (and two or three besides, belonging to the fifth pair, not constantly found,) either are seated upon the great sympathetic nerves, or are, as we shall experimentally shew hereafter, to be considered as their origins.

2. They appear to abound with blood vessels: and it is observed by *M. De Haller*, that the nervous filaments lose in Ganglions their rectilineal parallel direction, (No. 2. above,) and seem to be intimately commixed therein.*

3. The

* This was already observed by *Glisson*, who calls the ordinary unions of the nerves *affociations*; and those now called Ganglions, he calls *plexus*.
 “ Inter affociationes hæc & plexus id discriminis est, quod illæ fibras suas peculiares magis distinctas, minusq; invicem implicatas servant; quod etiam nodis ut plurimum careant,” *Glisson*, de Anatome Hepatis.

3. The bulk of a Ganglion constantly exceeds that of all the vessels and nerves which it receives, and of which it may seem composed.* Hence we may reasonably conclude, that in Ganglions the different nervous filaments are very intimately mixed; that a new nervous organization, or arrangement of the medullary substance, probably takes place in them, and is subservient to some important purpose in the animal machine; a conjecture which has the sanction of a *Winslow*, and the latest, as well as the earlier thoughts, of the great *Morgagni* in its favour,† though that purpose is not pointed out by them.

In

This is confirmed by the authority of Baron *Haller*, In Ganglio involu-
crum ex dura cellulosa tela est, five Vagina Rubens firma, ipsique etiam fun-
niculi nervei interrumpuntur, ut fibrarum porro rectarum parallelum duc-
tum, non distinguas, videanturque il funiculi intime commisceri. *Haller*
Elem. Ph. T. iv. p. 203.—Prim. Lin. No. 377.

* Gangliorum moles major est quam sit aggregatum omnium vasorum in-
gredientium atque egredientium; quo fit, ut ad eorum productionem, ne-
cesse sit concurrere, præter communia vasa, peculiare aliud corpus, non tam ex
coherencia & complicatione præfatorum nervorum, ac sanguiferorum, quam
ex novis organicis partibus quas provida solersque natura, subsistentibus pro-
beque excoctis liquidis, simul etiam elongatis varietate dispositis solidorum
fibris, fingat & creat. *Lancis.* de Gangl.

Certum est, ganglia constanter majora esse, & nonnunquam insignissime
majora quam nervus est ex quo quodque oritur. Certum est etiam, nervos
ex gangliis fere semper numerosiores prodire quam subierunt. *Haller, ib.*

† See *Morgagni* adversar. Anatom. T. ii. p. 71. & ejusdem de Sedibus &
Causis Morb. Epist. 12. Art. 14. Ces Ganglions sont composés d'un mélange
de Substance Moelleuse, & de substance cendree, arrosée de plusieurs petits
vaisseaux

GANGLIONS OF THE NERVES. 11

In order to determine the particular use of Ganglions, (the intimate structure of which, equally with that of the brain, and medullary substance of the nerves, we are hitherto ignorant of,) in the animal system, let us try if something tending this way may not be suggested, by reflecting on the functions and motions of the parts supplied principally by nervous cords from below the Ganglions.

The intercostal, more fitly called the great sympathetic nerves, abound most with Ganglions;* and by examining what is particular and peculiar in the motions

vaisseaux Sanguins. Traite' de la Teste. 629. Winslow.—See also his *Exposition Anatomique*, p. 462. 4to.—and following quotation. See also *H. A. Wrisberg, De Ganglio a Plexu semi lunari in abdomine* Comment. Gotting. vol. 2. 1780. Cum in plerisque nervis, ramorum divisio, percussa inter media cellulosa, ad ortum nervi continuari queat, illa tamen nervorum loca, ubi frequenter Ganglia filamentis intermixta sunt, a regula exceptionem faciunt. Ibid.

* Ces nerfs communement appelle's Intercostaux " Dans toute leur
" etendue, ils representent deux cordons, devise's & comme entrecoupe's
" d'espace en espace par un grand nombre de petites tumeurs ganglio-
" formes, moyennant lesquelles ils communiquent en arriere par deux
" fillets collateraux fort courts, & produisent en devant toutes leurs ra-
" mifications particulieres.

" Ces tumeurs ganglioformes, ou Ganglions, different plus ou moins
" en volume, en couleur & en consistance; & on les peut regarder com-
" me autant d'origines ou des Germes disperies de cette grande paire des
" nerfs sympathiques, & par consequent comme autant des petits Cerveaux."
Winslow Expos. Anatom. p. 462. 4to. edit.

Super omnes nervos, intercostali, Ganglia sunt frequentissima, in cer-
vice

motions of parts to which these nerves are distributed, we shall probably be led to the uses of Ganglions.

The muscular substance of the heart has its principal, or rather all its nerves, from the intercostals, which are always detached from the principal cords below the Ganglions, and chiefly from the inferior cervical Ganglion. The few nervous cords from the *par vagum*, or eighth pair, which in the human subject are sent towards the heart, are almost totally spread upon the pericardium and great vessels.*

In the abdomen, this nerve unites with the *par vagum* of the right side,† and they together form the

vice quidem tria; in thorace, lumbis, & pelvi tot, quot nervorum ex spinali medulla propagines intercostalis accepit: tum in cordis vicinia, sub diaphragmate, circa Arteriæ cælicæ & mesentericæ originem. & circa renem passim in plexuosis retibus. *Haller El. Phys. T. iv. p. 302.*

* Ibid T. i. p. 366. See also *Lancisi* de motu cordis & Tab. iv. v. viii. Neubaver nervorum cardiacorum, Deser. Lips. 1772. J. C. Walter nervor. Thoracis & Abdominis Tabulæ, Berol. 1783, fol. magn.

† *Winflow* Traite des nerfs, No. 141.—The reader is also desired carefully to examine the 23 Table of *Vieussens'* neurographia, which represents the course of the great sympathetic nerves, with their ganglions and connexions; and the accurate description of *Wrisberg* of this nerve, the result of dissection of sixty bodies. "Medulla spinalis, quantum quidem ego Scio, nulli abdominalium viscerum, furculum mittit, sed omnia illa nervorum filamenta, mediante nervo sympathetico maximo visceribus impertiuntur." *Comment. Gotting. vol. 2. 1780.*

the great femilunar Ganglion; from which, and from other Ganglions formed in inferior parts of the abdomen, filaments are distributed to the intestines, the liver, the spleen, the kidneys; and some of them descend to the fallopian tubes, uterus, and other parts in the pelvis; some of which are also in part furnished with filaments from the lumbar nerves.*

The

* The ancients traced only a very few nervous filaments distributed to the heart. *Fallopins* first traced the great number of nerves arising from Ganglions, which form plexus peculiar to the heart. His description of the great solar Ganglion, of the nerves which compose it, and of those sent from it to the abdominal viscera, as well as his description of the cardiac nerves, is so just and accurate, that though more modern anatomists have varied from it, they have seldom mended it. The descriptions of later anatomists differ indeed widely, respecting the origin, number, and distribution of the nerves sent to the heart.

That of *Willis*, erroneous in many respects, describes the cardiac plexus as derived from the intercostal nerves, and the eighth pair. He observes that the eighth pair sends more nerves to the heart in brutes, than in the human subject; a fact allowed to be true by *B. Haller*, and deserving the attention of physiologists and philosophers.

The descriptions and figures of *Vieussens*, taken with indefatigable industry from the dissection of five hundred bodies, are more conformable to truth and nature than those of any preceding writer; and till those of *Neubaver* and *Walther* appeared, have been exceeded by none. From them a few branches of the eighth pair, appear to be distributed to the pericardium and great vessels: but the *proper cardiac nerves*, which supply the muscular substance of the heart, arise below the Ganglions of the intercostals.

The less correct descriptions and figures of *Lancisi*, on the whole, agree with the above; but in particular instances of detail, immaterial to our subject, he differs both from *Vieussens* and *Winflow*; in whose new description

The heart and intestines, being wholly supplied by nervous filaments detached below some remarkable Ganglion, we must inquire what is peculiar in the motions of these parts, or in their structure: but the motions of the heart and intestines are remarkable, and exactly similar, in being both involuntary, or not liable to be either stopped, renewed, or in any way controlled by the will.

Though

tion we have new varieties, but still an agreement with preceding anatomists, "That all the nervous cords sent from the intercostal nerves to the heart, unite in one plexus, and that the nervous branches from the eighth pair are united and interwoven in it." In this agrees the description of *M. Walther* the elder, which *Haller* allows to be exact, though in various other points his descriptions differ from those of former anatomists, and are reckoned obscure by *M. Senac*. The descriptions of *Haller*, in his notes to *Boerhaave's Institutions*, seem an attempt to reconcile the contradictions of his predecessors. That published in *Comm. Gotting. 1770*, is professedly taken from the examination of the cardiac nerves of the human subject. He published only what he saw, nevertheless he is certain, many nerves escaped his observation, from the great difficulty of tracing them in any one subject. The late description of *Wrisberg* in *Comm. Gotting.* and the excellent figures of *Neubaver* and of *Walther* the son, though not in exact agreement with former anatomists, establish and confirm the fact, "That the heart has all its nerves from below the ganglia, and also that all the abdominal viscera are solely supplied with nerves from the great sympathetic nerves, united in ganglia with the eighth pair, after a large portion of it has been distributed to the stomach." In this essential point anatomists, who have written since the first publication of this Essay, agree with those who wrote before, however greatly they vary in other particulars.

The nerves of the heart are very numerous; no muscle, says *Senac*, receives so many; late dissectors agree with him on this point: they are formed into Ganglions and plexus's, are interlaced, united, and separated, before they are lost in the ventricles and muscular substance of the heart. These nerves convey the vital principle to the heart and intestines.

GANGLIONS OF THE NERVES. 15

Though it be very certain that these motions are excited in the heart, by the gentle stimulus of the blood upon the internal surface of that organ, and in the intestines by that of the secreted liquors, and of the food taken in; of which stimuli, these parts have

tines, so permanently, that when it seems lost in other parts, when the rest of the body seems dead, it survives for some time in them, and appears even when they are separated from the body, whether living or dead. From this living principle, communicated by the nerves, and excited by local stimuli, independent of volition, the action and motions of the intestines are carried on in the animal system. The same living principle renders the heart susceptible of motion by the stimulus of the blood, conveyed from the vena cava to the auricles, and, by them, thrown into the ventricles of the heart, and from thence into the arteries, to every part of the body, from whence it returns by the veins in a succession unknown, till it was demonstrated by the celebrated *W. Harvey*.

Let it once for all be observed, that the dissection of the visceral nerves is a most delicate and nice business: they can hardly be ever truly demonstrated in a few bodies, or in courses usually given by professors of anatomy. What *Vieussens* described after an examination of five hundred bodies, and *Wrisberg* by dissecting sixty, is not to be exhibited in a cursory demonstration on one subject. If it be true, as undoubtedly it is, that anatomical inventors are very few, those who truly describe the visceral nerves are still fewer; and the various inconsistencies in very good authorities, are to be accounted for from the different degrees of accuracy, or the different methods of dissection adopted by them; let preceptors in anatomy consider what they destroy, in any single subject, and what *Haller* says in the following paragraph, and they will censure less and instruct more.

"Quæ dixi (Elem. Physiol. de cordis nervis) ea vera esse, et vere a
 "me visa esse, non diffiteor, plena esse nunquam ipse speravi aut pro-
 "misi: satis memini, pone cor, loco impeditissimo, nervos esse numero-
 "sos, qui oblique introrsum descendunt, ab intercostalibus ut videtur
 "nati, quos ex ratione loci putes cor adire? Eos nunquam nisi mutilatos
 "vidi."—Dissertatio ad Figuram nervorum Andersch, Comm. Gotting.

2 Tom. 1771.

have the quickest and most exquisite perception; yet this being ordinarily not so strong as to make us conscious of its action, much less painfully so, can hardly be supposed to render these motions quite uncontrollable by the will, without some other efficient cause.*

Anatomy discovers no peculiarity in the muscular structure of these parts likely to account for this; and excepting in their nerves having Ganglions, which seem indeed appropriated to them, no anatomical difference has been observed, no mechanism which these parts have, more than, or different from those muscles which are subject to the will.

May we not then reasonably conclude, that Ganglions are the instruments by which the motions of the heart and intestines are from the *earliest* to the *latest periods* of animal life, rendered *uniformly involuntary*; and that this is *their use*?
which

* In an excellent explanation of the *vital and involuntary motions of animals*, by a learned professor and ingenious writer, in whose death the medical world has sustained an irreparable loss, it is remarked with the acuteness proper to this excellent author: "I imagine, that the mind's want of power over the motion of the heart, is not only owing to its being continually acted upon by a stimulus, but in part to an original constitution; and that though we should suppose this organ for a little while free from every degree of irritation, yet the mind by an effort of the will could not remove it." *Whytt's Essay on the vital and involuntary motions of Animals*, p. 316. I hope in this Essay to point out the *Constitution* here ingenuously hinted at.

which they subserve by a structure indeed unknown to us, (yet evidently different from that which usually obtains in nerves,) no less than that of the brain, though it seems not improbable the first may have some analogy to the last,

This conclusion concerning the use of Ganglions is supported by every truly parallel instance. Thus the motions of the *uvea*, or *muscular circle of the pupil* of the eye, ever contracted or dilated, as the eye is more or less irradiated with light,* are as much *involuntary* as those of the heart itself; though some unnecessary distinctions have been made concerning them, of which we shall afterwards take notice; and it is known to anatomists, that the muscular fibres of the *uvea* are supplied by nerves from the *lenticular Ganglion*, which seems formed solely for the use of that muscle, and for that purpose.†

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* Dilatation is the *rest*, or natural state of the pupil, as contraction is its *action*. It dilates in an obscure light and when the eye is directed to distant objects, and contracts when directed to near objects, and when a brighter light strikes upon the retina.

† See *Winslow's* description of this Ganglion, *Traite' des nerfs*, No. 22, 23, 24. It is known by the synonymous names of Ganglion lenticulare, Ciliare, and Ophthalmicum: the following is Baron *Haller's* accurate description of it: "Tertii Paris ramus, vel reliquus truncus, est radix præcipua crassa brevique ganglii, eademque extrorsum incedit, inque nervo optico, sub musculo abductore, efficit Ganglion ciliare sive ophthalmicum ovale, perpetuum, perminutum. Est ubi id a toto tertio nascitur, neque deesse unquam vidi, neque duo, aut plura fuisse, ut nuperi aliqui habent: — Nervi quinti Paris ramus primus ophthalmicus dictus, edit

When we consider that the nerves, which are more immediately ministerial to the soul,* and convey impressions of external objects to it, have no Ganglions; that they are never found upon the olfactory, optic, or auditory nerves; and that they are as rare upon the nerves instrumental in voluntary motion, as they are constant and numerous in parts whose motions are independent of our volitions, we have in this case the firmest grounds of belief that ganglia, on the latter, are placed as checks to the powers of volition; and that the former are exempted from them, because they would have interrupted and prevented the determinations of the will from reaching the parts intended to be subject to it, and upon sensory nerves, would have rendered the notices we receive much less distinct, perfect, and acute than they ought to have been.

The left nerve of the eighth pair, distributed to the stomach, and probably the cause of the distinct and exquisite sensation of that organ, and of its remarkable

"edit ramum, euntem in Ganglion ciliare, Ex eo ganglio furculi tendunt in uveam, fibrarumque radiatarum partem aliquam sed exiguam faciunt."
Haller Elem. Phys. p. 427—429.

* Nervos qui sensibus ancillantur, ut olfactorios, opticos, auditorios, aliosque nullis Gangliis munitos esse. Sunt enim sensus in corpore quasi quedam viæ ut Tullius ait, ad oculos ad aures ad nares a sede animi perforatæ; nulla idcirco in iis aut repagula, aut incitamenta addenda, vel interponenda erant. J. Mar. Lancis in Differt. citat.

remarkable sympathy with the head, seems also principally concerned in transmitting the sense of hunger to the mind, and therefore may be considered as a sensory nerve. This notion seems proved by, and in its turn throws light upon, those experiments made by the most celebrated anatomists, in which the eighth pair of nerves was cut asunder or tied in brutes, and by which the functions of the stomach were most manifestly disordered.* The latest and best anatomists agree there is no Ganglion found on this nerve, between its origin and the stomach, where it is chiefly spent.†

If Ganglions were not intended to check, and did not actually limit the powers of volition, the diaphragm had probably been entirely furnished from the intercostals, as most of the parts in the thorax above it; and in the abdomen below it,

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are.

* "Nervo Octavi Paris dissecto, Vox sublata est, & respiratio facta gravior, & concoctio ciborum destructa, & cibus in Ventriculum non venit." Morgagni in Comm. Bonon. & de Causis & Sedib. Morb.

"Nervo Octavi Paris ligato, respiratio difficilis, vox sublata est, ciborum horror, vomitus, ventriculus fecibus plenissimus, demum cibi omnino in ventriculo ita corrupti, ut solent crassis in intestinis esse." Brunneri nepot. Exp. in Haller Elem. Phys. Tom. iv. p. 324.

† "Nervi anastomoses inter se ut vasa, frequentes faciunt, & in concursu ramorum ex diversis truncis ortorum imprimis Ganglia reperiuntur. In sensoris unice nervis non reperiuntur, & nulla sunt Octavo, phrenico, nervis artuum." A. van Haller Prim. Lin. Phys. No. 377.

are. But as the motions of this muscular membrane were to be controulable by the will, we find peculiar nerves, namely, the phrenic, which are destitute of Ganglions, sent to it from a great distance.

S E C T. III.

Anatomical objections stated and answered: our doctrine supported by experiments, and by medical and anatomical facts.

THUS far have I stated the facts and arguments which tend directly to prove the doctrine I have advanced concerning the uses of Ganglions. And though I am sensible they may not have such force, and far less such advantage of arrangement, and of authority, as to compel conviction; and are rather likely to satisfy those who, laying aside prejudices of various kinds, are candidly disposed to give truth that peaceful reception which it so seldom has met with, than to stand the rigorous test of a captious controversy: I am, notwithstanding, persuaded that my main conclusion will be found to have a considerable weight of probability, yea, evidence in its favour, when weighed against those objections which may be brought against it, and those difficulties from which I am conscious it is not exempt. These however are chiefly such as arise from our imperfect knowledge of the nervous system; a terra incognita, which remains to immortalize the name of some future discoverer in anatomy.

It is well known, for instance, and it is almost the only objection of any weight, to which our doctrine is liable, "That all the nerves sent from the spinal marrow, have Ganglions where they send off the filaments which communicate with the intercostals,"* The concurrence of facts in favour of our doctrine, rendered it highly probable that these Ganglions respected exclusively the great sympathetic nerves, and that they were the first checks to the usual powers of volition, and affected only the filaments sent to the sympathetic nerves, leaving the other nervous filaments of the spinal nerves, fit and free for the conveyance of the commands of the will, as, in fact, they are chiefly distributed to muscles under its power and direction; but it did not till lately occur to me that this might be determined and proved one way or other by experiments.

It is allowed by physiologists, that when any nerve is irritated, the muscle it goes to, or if it is a large nerve, or bundle of nerves, all the muscles supplied from them, are by that irritation violently convulsed. [See Prop. 5—6. § I.]

If then, it shall appear, that irritations and injuries of the spinal marrow, (from which the intercostal, or great sympathetic nerves which supply

* *Vicussens Neurog.* Tab. 23.

ply the heart and intestines truly arise, as well as those nerves distributed to the limbs,) occasion violent convulsions of the limbs, and yet do not in the least affect the heart and intestines, parts the most irritable of any in the body; as will indeed be manifest by the following experiments: the difference will probably be accounted for from the intervention of Ganglion after Ganglion, constantly found betwixt the spinal marrow, and the heart and intestines: the subtlety of experiments in determining what no microscope or anatomical knife would detect and ascertain, will be acknowledged, and the unprejudiced inquirer into nature, will be led to ascribe those uses to Ganglions which I have done.*

I. On the 4th of *March*, 1767, a kitten a week old had its head cut off betwixt the first and second vertebræ of the neck: the thorax was opened with all expedition, and the heart laid bare to view, and observed for some time, that any difference might be more certainly noticed. After the animal ceased to move its limbs, I touched the spinal marrow with a probe; immediately the extremities of the animal were all strongly convulsed; but the heart alone, seemed unaffected, and continued to move

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without

* See *Prima Linæ Physiolog. Sect. 376.* — Edit. Götting. 1751; and *Menro on the Structure and Functions of the Nervous System. p. 30.*

without acceleration, or any degree of alteration whatsoever.*

Betwixt this time and *April* 10, I repeated the same experiment upon half a dozen kittens, still younger than the first; upon opening the thorax the heart beat at least seventy strokes in a minute.

When the heart beat only forty in a minute, or thereabout, I began gently to touch the spinal marrow with the point of a probe, and the limbs were immediately convulsed, but the heart not in the least affected.

I slit open both the ventricles of the heart, so as to let out all the blood they contained, and instantly the heart ceased to beat; (though before the blood is thus removed its pulsation continues very long in animals so young, especially of this kind;) but the auricles which were not opened, and therefore were still stimulated by the blood, beat on.

After this preparation in several of these animals,
I thrust

* "Convulsionēs totius Animalis, ab irritata medulla spinali natæ, cordis motum non suscitant." *Haller Elem. Phys. T. ii. p. 205.*

These experiments were tried, and their events, as here related, observed, long after the first draught of this Essay had been sent to the Royal Society. I therefore appeal to such persons as may chuse to repeat them, disagreeable as they are, whether I misrepresent them through prejudice, or not.

I thrust the probe into the spinal marrow, but the heart nevertheless continued in perfect rest and inaction: though when its substance was pricked with the point of a knife, it might still be made to contract.

But though the heart and intestines remained equally unaffected in all the trials I made, by thrusting the probe into the spinal marrow, the following convulsions occasioned by it deserve particular enumeration.

All the limbs were violently convulsed.

The muscles of the back were convulsed, and the spine bent as in the opisthotonos.

The intercostal muscles were all contracted, and their natural action, that of drawing all the ribs nearer each other and upwards, was rendered a matter of ocular demonstration.

The diaphragm was contracted strongly, notwithstanding the phrenic nerve of one side was divided, in making similar experiments, by pricking and stretching it; which, by the way, constantly occasioned a convulsive contraction of the diaphragm.

Even by plunging the probe into the brain, after

ter the head had been cut off some minutes, the eyes, tongue, and lower jaw were made to move.*

I have made the same experiments, with like consequences, upon frogs.

But these experiments must be made within less than a quarter of an hour after decapitation; half an hour after, no such effects follow the destruction of the spinal marrow: and they succeed best by previously opening the ventricles of the heart. By the way, the irritability of the muscles continues not longer than the power of exciting contractions in them by irritating the corresponding nerves.

Experiments, similar to these in event, have been made on frogs, by *Stuart*, *Baron Haller*, *Dr. Whytt*, and many more.

“ When I opened (says the last of this ingenious triumvirate) the thorax of a frog, immediately after decollation, and destroying its spinal marrow, I observed its heart beating after the rate of sixty in a minute, which is four or five
“ pulsations

* In an account of the execution of *Mary Queen of Scots*, it is declared that her lips stirred up and down almost a quarter of an hour after her head was cut off. *Ballard's Memoirs of the learned ladies of Great Britain*, p. 166.

GANGLIONS OF THE NERVES. 27

“ pulsations less than I have generally seen the
“ hearts of frogs make in that time, when the
“ thorax was opened without decollation.*

II. “ Some young gentlemen having hanged a
“ cat, till she was quite dead, opened the thorax,
“ and observed only a tremulous motion in the
“ heart, which soon ceased, but was renewed by
“ pricking it with a sharp instrument: after this,
“ by squeezing the cardiac nerves downwards, or
“ otherwise irritating them, the heart was made to
“ perform two or three pulsations, which it con-
“ tinued to do for a considerable time, whenever
“ the cardiac nerves were thus stimulated.”† These
experiments were made with no kind of view to
the doctrine which I shall endeavour to shew they
enforce and support.

III. Animals are killed, some sooner, and others,
especially of the cold kind, (as frogs and tortoises,
on account of the largeness of the spinal marrow,)
much later, by cutting through the spinal marrow
near its origin. The cutting through the intercos-
tal nerves, or the tying ligatures upon them, is also
sooner or later *fatal* to the animals the experiments
have

* See *Whitt's Exp. on living and dying animals*, Eff. Ph. and Lit. 2
vol. p. 382. and *Whitt's Physical Essays*.

† *Essay on the vital and involuntary motions of animals*, by *Whitt*,
p. 355.

have been tried upon, by finally destroying the *heart's motion*, and instantly, in a wonderful manner, *weakening and disturbing its motions*.*

These experiments prove that the Ganglions on the spinal nerves do not hinder the irritation of the spinal marrow from causing convulsions in the voluntary muscles: and that the Ganglions (1) do, in all probability, hinder that cause from acting (as without their intervention it must have done)

* *Octavæ conjugationis nervis, una cum nervis par intercostale constituentibus, circa cervicem ex transverso recisis, animal illico languore futuræ mortis prænuncio afficitur, tremulos motus patitur, vires illius sensim labascunt, & intra 24 circiter horas, vita destituitur, quæ per illud breve temporis spatium, spiritu animali sustinetur, quem medulla spinalis, & nervi plexus intra medium & infimum ventrem latitantes naturalibus & vitalibus partibus suppeditant. Vieussens neurographia, cap. iv. Lower de Corde. Haller, Elem. P. T. i. p. 464—5. And Morgagni de Sedibus Morb. Exp. xix. art. 23. describes the encheiresis, or manner of making this experiment, and observes, it is impossible in brutés to cut or tie the intercostal nerves or par vagum, separately, without dividing or tying both together; a fact, which has not been always considered in reasoning upon this experiment.*

The experiments made by cutting and tying the splanchnic nerves are favourable to our doctrine.

In the experiments of the ingenious Dr. *Whyt*, 2 vol. Essays physical and literary, it appears that the destruction of the spinal marrow and decollation do not so immediately weaken and put a stop to the heart's motion in frogs, as opium injected into the stomach and guts, or applied to the muscles and bowels of the lower belly and thorax. The same observation holds as to the effects of laurel water. Hence also it appears, that the motions of the heart and intestines depend more directly upon the influence derived from the Ganglions, than that of the brain itself. The experiments of dividing and tying the splanchnic nerves, favourable to

done) upon the heart, by means of its nerves, chiefly arising from the spinal marrow originally: and therefore it seems evident, and beyond a plausible conjecture, that the Ganglions on the spinal nerves relate exclusively and solely to the intercostal, or great sympathetic nerves, for the purposes I have endeavoured to prove: this doctrine derives farther confirmation from experiment (2,) as we thereby see that the heart may be made to move, as all other muscles may, by irritating or squeezing its proper

our opinion, have been performed by many anatomists. I mention principally ligatures made on the eighth pair of nerves, confounded for the most part in the descriptions of anatomical writers, till *Vieussens* properly distinguished them. The eighth pair was tied by *Riolan*, and both cut and tied by *Plempius*, *Lower*, *Willis*, and *Boyle*. The same experiments have been repeated by *Chirac*, *Courten*, *Berger*, *Baglivi*, *Morgagni*, *Heuerman*, *Bohn*, *Varignon*, *Senac*, *Brunner*, and *B. Haller*. The animals all survived for several days. The motions of the heart were weakened in some, though not very visibly in others. The most constant effects, were a sinking of voice, or aphonia, difficult respiration, and palpitations of the heart; vomiting, and endeavours to vomit, as in the experiments of *Haller* and *Brunner*, in dogs and rabbits, and an appearance of putrescence in the contents of the stomach. A proof that the stomach derives its action and vigour, in a very great degree, from this nerve. *Haller* adds, "Neque vidi irritato octavi paris nervo, cordis motum acceleratum fuisse, pulsum vehementiorem successisse, aut sanguinem validius erupisse. "Neque ab octavo pare irritato cordis motum suscitari vidit *Senac*." *Hall. El. Ph. T. i. p. 463.*—in 4to. When we recollect that these ligatures, sections, and irritations, are made high in the neck, and above the ganglia of the nerves, we are enabled to account for the events here described, and see in them evidences of the uses here assigned to the Ganglions of the nerves.

The section of the great sympathetic nerves, kills animals much sooner, than that of the eighth nerve only. Yet *Vieussens*, *Heuermann*, and *Senac*, found

proper nerves, below their Ganglions: and, that the motions of the heart cannot long continue, in warm animals especially, after the division of their principal nerves, (3) which shews the dependance of the heart (*Prelim. Prop. 6*) ultimately, as that of all other muscles, upon its proper nerves, and their connection with the brain.

These conclusions have received additional proof from new experiments and discoveries in animal electricity,

found them survive that experiment from ten to thirty hours. Even after the sympathetic nerves and eighth pair are both cut through, animals live some time. Even the cutting through the spinal marrow near the head, which intercepts all communication with the brain, and is instantly fatal, does not immediately arrest the motion of the heart.

Several instances have occurred in my practice in which the spinal marrow has been injured by falls, or branches of trees, or other ponderous bodies violently falling on the spine. By these accidents the spinal marrow has been wounded, and in some instances half cut through, sometimes just under the points of the scapulae, in others higher or lower in the spine. In all of them entire immobility of limbs, and insensibility in the hips, thighs, and lower extremities, has followed. The bladder is seldom emptied without the catheter, and yet the stools came away involuntarily. The pulse gradually sinks, the belly becomes tympanitic, and the patient dies in a week or fortnight, according as the injury has been greater or less, or higher or lower in the spine. Similar diseases affecting the spinal marrow, arise especially in scrophulous persons, without external injury. A tottering debility, ending in palsy of the lower extremities, announce the disease; a flatted vertebra, or gibbous spine, points out its cause: it is often cured by issues made by means of caustics, and sometimes by the use of the Bath waters. The cyder, or saturnian cholic, often ends in similar complaints, without any visible alteration in the spine. Such persons have more than once fallen under my care, and been cured by warming and stimulating balsamic and

electricity, by *Galvani*, *Volta*, *Dr. Valtz*, and others.

But the objection is entirely obviated by a discovery made by *Dr. A. Monro*, the present celebrated professor of anatomy at Edinburgh. "When (says he) we carefully trace the anterior and posterior bundles which form the spinal nerves, we find each has its proper hole in the spinal sheath of the dura mater, and it will be found that the posterior

and aperient medicines; the Bath waters have also good effects in such cases.

Lastly, when the heart is cut out of the body, and cut in pieces, they continue to move and palpitate: the experiments have been often repeated on serpents, turtles, frogs, and many young animals.

It is in vain that *Haller*, and others, ascribe this animation, or vital principle, to a vis insita in muscular fibres only, exclusive of a power derived from nerves, which are so intimately and inseparably mixed with all muscular fibres, that stimuli must simultaneously act upon the nerves and muscular fibres they are applied to: the nerves actuate these muscular palpitations, for a time, out of the body, as well as muscular actions within it. The nerves animate the heart and other viscera for a considerable time, and to a considerable degree, after they are divided, and all communication interrupted with the brain and spinal marrow. Such facts absolutely decide against the old hypothesis of *animal spirits* and their inconceivable velocity, and leave us in doubt whether their structure be tubular or not: these facts, in fine, leave us still ignorant how the nerves act: and no dawn, no ray of light, pierces into those sublime secrets of nature, which are alone unveiled to that self-existent Being, who animates every living creature.

The organization of the nerves, similar in all appearance, to that of the brain, and possessing for a limited period something of its energy,
even

terior bundle only ends in the Ganglion, and that the anterior bundle, which does not pass through the Ganglion, does not incorporate and unite with the posterior till it has passed through the Ganglion." See on Structure and Functions of the Nerves, p. 30.

The intercostal nerve receives the nervous branch detached from the posterior bundle of each spinal nerve, only after it has passed through its proper Ganglion :

even when separated from it, is confessedly unknown. Nevertheless, it must be conceived as much more artificial than that of other parts, as the functions of the brain and nerves surpass those of organs destined for grosser purposes. If we can hardly consider without wonder, the powers of organs which digest and assimilate food, into the proper substance of our bodies, what must we think of an organization which makes impulse subservient to sensation, and is the instrument of every mental power. In like manner we are ignorant of that organization in the nervous Ganglions, and by what means they check volition, and blunt ordinary perception, as they evidently do, and yet do not prevent the nerves derived from them, from supporting and animating the great organs of life; all of which are moved by local stimuli, irritating the nerves spread in these parts in a manner wonderfully uniform, yet best adapted to produce effects, which are as various, as they are necessary to the preservation of human life.

Since the first publications of this treatise, (1764—1771) I find the celebrated Fontana and others have observed that long pins thrust into the vertebral canal, occasion convulsive movements in the limbs of frogs and other cold animals, without accelerating or altering the motions of the heart. He concludes, "The nerves then which are carried to the heart, are no way the organs of motion in this muscle." Vol. ii. p. 194. The same paradox has been repeated in a late publication at Mentz, by M. Behrends. Had Mr. Fontana considered the situation of the ganglia on the nerves sent to the heart and abdomen, his difficulty would have been solved;

Ganglion: but the anterior bundle is wholly appropriated and distributed to the voluntary muscles, as has been distinctly noticed by *Haller*, Sect. 376. Prim. Lin. edit. Gott. 1751. His words are, "omnes nempe nervi spinales, vix uno alterove in collo excepto, egressi de vertebra, posteriorem et anteriorem truncum habent. *Ille musculus unice datus est. Iste* producit radicem nerveam, quæ juncta solaribus, et addito exiguo furculo, qui a sexto nervo cerebri, advenit, unum principem corporis humani nervum efficit, qui cum fere omnibus aliis nervis totius corporis conjunctus, ad cor, et abdominis viscera omnia ramos nerveos educit." This fact com-

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solved: he would have found his experiments beautiful proofs, that the interposed ganglia prevented his experiments from altering the motions of the heart, and also prevent the action of volitions there, and withall, the general confusion of voluntary and involuntary action, from disturbing the functions of the heart, intestinal tube, and internal glands.—Proceeding with the same precipitation of conclusion, he denies that the passions act on the heart, by the nerves.—In opposition to *Fontana*, I assert that the heart is affected by the passions of the mind, acting through the medium of its nerves, just as a palsied limb, immoveable by cool volition, is sometimes acted upon by the violent emotions of fear, or anger suddenly produced: yet the palsied state remains after this violent excitement ceases. A paralytic limb has sometimes resumed power to convey off persons violently alarmed by fire: a paralytic arm has been stimulated by the sudden transport of an affront to give a blow. In this manner the energy of passion agitates the heart by the medium of the cardiac nerves, though it remains unaffected by cooler volitions.—Besides this direct force of passion, the nerves of the heart are also in a thousand different ways, indirectly affected by the passions of the mind. Their influence is felt in every part, in every nerve and muscle. Breathing is accelerated, or as it is expressed, shortened, the muscles of respiration are quickened in their contractions; the stomach rejects its contents;

pletes the proof of the uses I have here assigned to the Ganglions of the nerves.

It is objected, "That one or two Ganglions are
" often observed upon a filament of the second
" great branch, and another upon the third branch
" of the fifth pair of nerves."

The constancy, and, if I may so express it, the solicitude with which all parts whose motions are involuntary, are provided with nerves, furnished and beset with Ganglions, and the great scarcity of them on nerves detached to muscles subject to our volitions, and the total want of them on the sensory nerves, sufficiently bespeaks their general destination and use; notwithstanding a few seeming exceptions: seeming, I say, because those few alledged as such, are not permanent parts of animal structure, or constantly found. As their appearance is in some measure accidental, we have reason to suspect

sents; and the biliary ducts throw out their liquors: the kidneys and bladder are stimulated to frequent evacuations, the limbs universally tremble, and the countenance grows pale and reddens by turns. In an agitation which is more or less universal, the heart is acted upon directly through the medium of its proper nerves, but likewise indirectly by sympathy; whence the affections of every external and internal part re-act upon it: the blood accelerated in its movement, as appears by the pulse, often acquires a feverish velocity during the act and influence of passion, wherein the quickened motions of the heart, must correspond with the rapidity of the blood's movement. In such various ways do the passions act upon the motions of the heart through the medium of its nerves.

suspect them sometimes to be rather morbid phenomena, than organs of great importance in the animal system: the ganglia in particular of *Mekelius*, found on the second and third branches of the fifth pair of nerves, are very essentially distinguished by Baron *Haller* from other Ganglions; particularly the Ganglion ophthalmicum, which, he says, is constant and perpetual; whereas the other Ganglions of the fifth pair are not so, for he remembers to have examined bodies, in which they were wanting.* But, supposing the utmost in favour of the constancy of these ganglia of the fifth pair, the nervous twigs on which they have been observed, being chiefly distributed to the salivary and mucous glands, about the jaws, tongue, palate, throat, and nostrils, may they not be supposed to have some use in glandular secretion? For we see the glandular parts in the abdomen, are supplied by the great sympathetic nerves, as well as the muscular fibres of the heart and intestines.

Soon after my papers on the uses of the Ganglions

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* These Ganglions have been seen on a twig of the super-maxillary branch of the fifth pair, with respect to which Baron *Haller* says, "Me-
"mini in aliis Cadaveribus eodem loco nullum adfuisse." *El. Ph. T. iv.*
p. 213. The same he observes with respect to another Ganglion, some-
times seen on the lingual branch of the third great branch of the fifth
pair, the maxillaris inferior, it was sometimes not found. *Ibid. T. iv.*
p. 218—219. The pterygoid branch, on which a third Ganglion has
been seen, sends one or two twigs to unite with the intercostal nerves at
its origin.

glions of the nerves, appeared in the *Phil. Transf.* 1764, the applatifement, or remarkable plexus on the trunk of the fifth pair of nerves, was, by *Gasserius*, a professor of anatomy at Vienna, noticed as a Ganglion, overlooked by former anatomists: overlooked, indeed, as a Ganglion, it had been; nor has its pretensions and existence as such been since admitted. I have examined the recent subject, and find the fifth pair of nerves, as it dips under the dura mater, and immediately before its division into three principal branches, is subdivided into lesser cords, in like manner as the cauda equina, in the lower part of the spinal marrow, is divided before its final separation in distinct nerves.

The division of these cords in this pair of nerves, is made by cellular fibres under the dura mater, occasioning that remarkable flat enlargement of the nerve, well represented in the figure of *Wrisberg*, just before the three great divisions go off in separate foremina. This had been noticed by *Winslow*, the elder *Monro*, and *Haller*. *Gasserius* first called it a Ganglion, and that immediately upon the publication of my paper. His doctrine appears to have been supported by his scholars, but is generally rejected by later anatomists.

Dr. *Monro* is the only writer of reputation, who, so far as I know, considers it as a Ganglion, and
objects

objects it to my doctrine, in the note in page 58 of his work, already referred to : and, in endeavouring to support his opinion by authority, he makes an unlucky reference to *Wrisberg's* description of the fifth pair of nerves, who employs a chapter to demonstrate *that it is not a Ganglion*: and I concur with him. — The following are *Wrisberg's* words : “ Multum nostris temporibus disputatum est de ganglio formi quinti paris, ante suam in tres ramos divisionem, intumescencia, quam in memoriam vindobonensis prof. *Gasserii* Ganglion a variis appellatur. — *Omnia e contrario argumenta conspirant, ut confidenter et certo asserere audeam, merum plexum esse, et illaqueatam nervorum filamentorum conjunctionem, quod Gasserii Ganglion alias audit, & quod a figura intumescencia semilunaris convenienter appellari deberet.*” Vide *Wrisberg* de quinta pari nervorum, sect. 2. De intumescencia semilunari. Supported by this authority, as well as *Autopsia*, I do not admit that this is a Ganglion,

It has likewise been objected, “ That the great sympathetic nerves send some branches to parts, “ under the controul of the will, as the pharynx “ and diaphragm, as well as to the heart and intestines, not subject to that controul.”

It is well known, that though the pharynx derives some nerves from the great sympathetic

nerves, its most considerable supply of nerves comes from the eighth pair: and the diaphragm is rendered paralytic by tying or cutting the phrenic nerve distributed to it; which shews that its motions have very little dependance on the minute filaments which it receives from the great sympathetic nerves. There are other motions in these parts, besides those of the voluntary kind; these motions being of the *mixed* kind, sometimes being *involuntary*, at others voluntary. There are other parts also, as well as these now named, whose motions are of the mixed kind; and it is remarkable that all of them have two different kinds of nerves; namely, some without Ganglions to subject them to the powers of volition, and others that have Ganglions to supply the involuntary motions of the same parts. Thus the diaphragm moves, when we are asleep, and when we are awake, though not quite so often; and continues to move, though less frequently, even during a profound apoplectic fit. In like manner, we can raise the pharynx by an effort of the will; yet in the actions of deglutition, its motions are chiefly involuntary, from the stimulus of the food passing down the gullet.* In the involuntary motions, the stimulus which excites, regulates their intenseness and continuance;

* See Essay on the Vital and Involuntary motions of Animals.

ance: in the voluntary motions, the will excites and regulates them all.

We are not to imagine, nor do I know that it is generally supposed by anatomists, that wherever the nerves unite, their medullary substance either decussates, or is so intimately mixed, as is reasonably supposed to be the case in Ganglions, by most anatomists, from *Glisson* down to *Haller*: we know at least, that this is far from being the case in the *optic* nerves; for though they unite, and were supposed to cross each other, the contrary appears by observations, made in the bodies of persons who were blind of one eye from a fault of the optic nerve; the nerve of the affected side only being wasted, while the other was large and plump.* And we may justly infer, the *Plexiform unions* of the nerves, distributed to the superior and inferior extremities, not to be more intimate, nor intended to serve any such purpose as Ganglions, since these nerves are equally motory and sensory; no other nerves being distributed to the skin, the organ of touch, but from the sub-division of these plexuses.

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* See the anatomy of the nerves in general, by a late justly celebrated professor of anatomy, Dr. *Monro*, sen. p. 356. and No. 23. *Sanctorini* obs. Anat. 63. *Vesalii* Anatom. Lib. iv. C. iv. "*Vesalius*, *Aquapendens*, "*Valverde* aliquando observarunt, toto ductu divisos opticos nervos manifestasse, & eum tamen in quo sic conspexit *Vesalius* de visu nunquam con-
"questum fuisse, visuque præstanti semper valuisse." *Morgagni* de sedib. Morb. Ep. xiii. Art. 7.

S E C T. IV.

Physiological difficulties obviated. Conjectures concerning irritability, muscular motion, sympathy, &c.

IF these anatomical difficulties do not subvert our doctrine, the following of a physiological nature, it is presumed, will not be more formidable; or perhaps may become arguments in its favour, when properly considered.

It has been objected, " That if the Ganglia intercept the communication between the sensorium commune, and those parts whose nerves are derived from them, they ought not only to intercept the commands of the will, and render the motions of these parts not voluntary, but they ought also to prevent the impressions made on the nerves of these parts, from being conveyed to the sensorium commune; *i. e.* these parts ought to be insensible: the contrary of which is true. For example, the intestines, whose nerves come from Ganglia, are among the most sensible parts of the body: and if the

" uneasy

“ uneasy sensation in the lungs, in asthmatic cases,
 “ was not conveyed to the sensorium commune,
 “ how could the will redouble the action of the
 “ diaphragm and the intercostal muscles?”

I. To this it may be answered, that an anastomosis, or new arrangement of the nervous filaments which appears to take place in Ganglia, may intercept the efforts of the will, and also render the sensations of parts wholly supplied with nerves from Ganglions, less determinate and precise than in other parts, which indeed is a fact; yet, without rendering such parts totally insensible. Paralytic diseases show, that the nerves may be so affected, as to be incapable of conveying the commands of the will, and yet remain sufficiently capable of reconveying sensible perceptions. In the palsies which are most frequent, the parts rendered perfectly immoveable by the disease, have as quick a feeling as those that are moveable by the will; and what deserves attention, are often moved involuntarily, especially upon the application of any painful stimulus: and it is observable too, that paralytic limbs, which are not to be moved by our volitions, are often called into action, when the paralytic person is suddenly thrown into any violent passion; just as we observe the same cause to produce extraordinary commotions in

in the heart and intestines, &c. though the will, coolly exerted, has no power over these parts.

II. Various observators have shown that the feelings of the organs, whose motions are involuntary, are by no means exact, nor always acute. We have it on the authority of *Harvey*,* confirmed by Baron *Haller*, that the heart, though highly irritable, is when touched, very dully sensible, as has also appeared in wounds and contusions of this part.† *Haller* asserts that the lungs, liver, spleen, and kidneys, all supplied from the great sympathetic nerves, have been cut in pieces, and yet the animal seemed to feel no pain. And (which is a proof less liable to exception) operations and diseases in the kidneys, and ulcers in the lungs being but little painful, show the feelings of these parts not to be exquisite.‡

III. The stomach, which has a very large portion of the eighth pair of nerves bestowed upon it, loses its sensibility and contractile power so perfectly by ligatures of this nerve, that the food neither passes down the œsophagus, nor is concocted in the stomach; and by spontaneous corruption there puts
on

* *Harvey* de Generat. Animal.

† *Phil. Transf.* Vol. lii.

‡ *Haller's* celebrated Essay on sensible and irritable parts.

on the appearance of the faces themselves, so fatid in the large intestines.* 'Tis in consequence of the sensibility which the stomach derives by means of this nerve, along with its peculiar organization, that the stomach becomes the principal seat of hunger; and, to use the words of a celebrated writer, "As it is affected with a more disagreeable sensation, when we have wanted food for any considerable time, than the guts; so likewise it is more sensible of an agreeable feeling, from grateful food: and in these respects it may be said to be *more sensible* than the intestines."†

IV. A less precise feeling the intestines certainly have; and though in many instances they are the seat of exquisite pain, yet in consequence of the *connexions* of the nervous filaments in the Ganglions, any painful disease seated in the intestines, or in the other viscera contained in the abdomen, is by sensation less determinable to its particular seat, or rather is more apt to affect the parts adjoining, than diseases of a painful nature which are seated in the stomach itself, and in other parts whose nerves are not supplied with Ganglions.‡

And

* See Morgagni & Vieussens locis citatis.

† See Whytt's Path. Essays, p. 155, first Edit.

‡ Ut anima non adeo accurate locum dolentem distinguat, sed obiter utcunque, et aliqua latitudine. A. V. Haller El. Phys. T. iv. p. 407.

And this leads us to a natural solution of that sympathy, that *intercommunion of sensations*, or, *that imputation of painful sensation*, which so frequently takes place in the cholic, inflammation of the intestines, and nephritic complaints, and other diseases of the contained parts of the abdomen, from which some writers* have very conclusively argued for the necessity of such a communication of the nervous filaments in Ganglions, as appears indeed, to take place in them, and which, among other important uses and consequences, seems the occasion of many of those sympathetic sensations in the lower belly, so frequently taken notice of, and so difficult to be explained.†

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* Zinn. de oculo, citat. Haller, El. Phys. T. iv. p. 321.

† The celebrated Whyt's objections to particular sympathies, arising from a connexion of nerves in Ganglions, seem inconclusive: for, says he, such a communication as is supposed in Ganglia to occasion sympathy, would cause a *confusion* in our sensations, as well as in the *motions* of our muscles. With respect to *sensation*, we have seen that *confused* or *indeterminate sensation*, is proper to parts whose nerves arise from Ganglions; and that the muscular motions of these parts are not regulated by the will, but by the application of an irritating cause; and therefore, instead of proving that sympathy in the abdominal viscera does not arise from Ganglions, they render it likely that it does. The mind undoubtedly feels sympathetic, as well as all other sensations, only at the origin of the nerves in the brain, where the soul sits enthroned: yet facts incline me to think with Willis, Vieussens, Haller, and Monro, that sympathy depends in many cases upon the *connexions* of nerves in their course, as well as at or near their origin.

It is objected also, "That every voluntary muscle in the body becomes involuntary when it is strongly stimulated: for example, the *acceleratores urinæ*, are quite voluntary in the action of expelling the urine, but act involuntarily in expelling the semen."

When we consider the state of the soul and body under any violent passion of mind, we find the usual operations of the soul itself are not only disturbed, but those parts of the body too, which the will cannot controul, are now agitated by the storm; for every one has experienced that the heart and viscera in general are vehemently affected by strong passions: the mind is in like manner violently re-acted upon by very strong bodily sensations;

It is well known, that an irritating cause acting upon a nerve in any of the limbs, will sometimes extend its efficacy as far back as the brain, and occasion convulsions, or epileptic paroxysms affecting the whole body sympathetically; at other times it only affects some particular parts of the body, as in the case of the locked jaw, spasmus cynicus, and various other instances which I purposely omit. In like manner any violent irritation, which by its stimulus affects any of the filaments of the intercostal nerves up to their origin in their respective Ganglions, will also act by consent upon, and affect all the filaments which have their common origin in such Ganglions: and hence sympathetic symptoms will arise in the first place, in the parts of the abdomen and thorax supplied by the great sympathetic nerves, and afterwards in the rest of the body, nearly in the order in which these nerves are connected with the rest of the nervous system. The reader will find that the celebrated *De Haen* has adopted the *Winslowian* opinion, that the Ganglions are the origin of the intercostal nerves, and attempts with great probability to explain from thence the singular

fations; for it is well known that muscular parts which are ordinarily subject to our volitions, cease to be so, if any part is stimulated by exquisitely pleasing, or excessively painful sensations; under such a stimulus they are necessarily contracted or convulsed. But, it is not therefore to be concluded, that the gentle stimulus of the blood, on the internal surface of the heart, and of the air, food, and gastric juices, on the intestines, of which the mind has no conscious perception at all, much less a disagreeable one, can lay it under any similar necessity, as some have argued. This objection can have no force against our doctrine, however it may recoil upon that of others; as all voluntary muscles whatever may be excited to contractions by irritations excessively pleasing or painful; the contractions from such causes being involuntary, necessary, and uncontrollable:

singular paralytic symptoms sometimes left by the saturnian cholic. This general account of sympathy is supported by so many facts, that I think one may safely venture to foretel, it will derive proof and confirmation from such new discoveries as will advance the knowledge of the nerves, and enable future ages to see things clearly on this subject, which at present are dark and inexplicable to us.

In, universum quidem nervorum systema nexum quandam & communicationem servant. Oculorum paria, cum inter se, tum mediante 5to, 7mo, multiplici ratione conjuncta sunt, octavum mediante intercostali, cum omnibus spinalibus, phrenico, et nonnullis cranii conjunctum: præcipuum autem totius systematis nervosi perficit nexum intercostalis, qui primos fere cranii nervos, cum ultimis in sacro osse exeuntibus nequit, Caput itaque truncum, artusque in unum conjungit. *H. A. Wrisberg.* De Ganglio & Plexu semilunari in Abdomine, Com. Gott. 2 vol. 1780.

controulable: but the stimuli that affect the heart and other parts, whose motions are naturally involuntary, are not of this class, nor of this strength; and indeed, are so little perceived by the mind, as to lay it under no such necessity, as in the instance objected. Those on the contrary, who, observing that we are not conscious of these motions, infer from thence, that the self-thinking individual or human soul, is not the real author of them; and who, instead of referring them to unknowing nature, attribute them ultimately to its great Director, seem to me, to reason very conclusively.*

To what other immaterial power can we refer the support of the vital motions, which have for their cause irritability? A principle or cause not immediately extinguished by death itself, and which exists in the heart and intestines, not only when

* See *Baxter's* inquiry into the nature of the human soul. A performance in which the justest notions of the soul's authority in and over our bodies, and of the divine government co-operating therein, and controuling universal nature, are excellently deduced and supported upon the foundations of sound reasoning and true philosophy.

"The great mysterious Being, who made and governs the whole system, has set a part of the chain of causes in our view; but we find, as he, himself is too high for our comprehension, so his more immediate instruments in the universe are also involved in an obscurity that philosophy is not able to dissipate; and thus our veneration for the supreme Author is always increased in proportion as we advance in the knowledge of his works: as we arrive in philosophy towards the first cause,

"we

when they are separated from the head, and the rest of the body, but when divided into a thousand parts, each piece retains it.

Is it then an inherent property of muscular fibres? Sound philosophy teaches us, that activity in matter can never be inherent, but must be impressed by some immaterial, and as seems probable, in the present case, active percipient power.

As irritability exists in muscular fibres separated from the body, the soul does not seem to be that active power. For the soul is seated in the brain only, and is acted upon, and puts muscles in action, by means of nerves (*Prop. 4, 5.*) continued from the brain. Hence when the nerves are compressed, tied, or cut through, the soul loses its power, and yet, irritability remains, even in muscles

" we obtain more extensive views of the constitution of things, and see
 " his influence more plainly: we perceive that we are approaching to
 " Him, from the simplicity and generality of the laws or powers we discover,
 " cover, from the difficulty we find to account for them mechanically,
 " from the more and more complete beauty that appears, &c." *M'Laurin's*
View of Sir Isaac Newton's Philosophy. Cap. 1.

The following passages from *Cudworth's Intellectual System*, will, perhaps, induce my readers to look into an excellent old book. " As we
 " have no voluntary imperium at all, upon the systole and diastole of the
 " heart, so are we not conscious to ourselves of any energy of our own
 " soul that causes them, and therefore we may reasonably conclude from
 " hence

cles of the voluntary class. Those that are involuntary, and over which the soul has no authority at any-time, possess this property nevertheless, in the most eminent degree.

Detruncations of the body, diminish not the faculties of the soul, which remain perfect unless the brain be injured. The soul is not a divisible or discernible substance.

Irritability therefore, though capable of being occasionally excited by the soul, as a kind of irritant, through the medium of the nerves, seems to have a different percipient agent for its cause, and to be derived only from that immaterial Being, who created all bodies, is the source of all active force that appears in them, and presides over the universal frame of nature.

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"hence also, that there is some vital energy, without animal fancy or
"synæsthesis, express consciousness and self-perception." P. 61.

"In the efformation of the bodies of animals, it is one and the self-
"same thing that directs the whole; that which contrives and frames the
"eye, cannot be a distinct thing from that which frames the ear; nor
"that which makes the hand, from that which makes the foot; the same
"thing which delineates the veins, must also form the arteries; and that
"which fabricates the nerves, must also project the muscles and joints;
"it must be the same thing that designs and organizes the heart and
"brain, with such communications betwixt them; one and the self-same
"thing must needs have in it, the entire idea and the complete model
"or platform of the whole organick body. For the several parts of mat-
"ter distant from one another, acting alone by themselves, without any
"common

I shall not enlarge this digression, by endeavours to explain how the *soul* acts upon the *nerves*; and how, by means of these, the irritable muscular fibres are, by an act of the will, made to contract: how the more violent agitations of the soul, by the medium of the nerves, affect the irritable, but involuntary vital organs. What the nerves contribute towards the contractions of *muscular fibres*, and how far their efficacious energy is necessary to such contractions, (see Prop. 6.) Of these we say, in the words of *Pliny*, L. 2. C. 37. *Omnia incerta ratione, & in naturæ majestate abdita.*

There is in all fibres of animal bodies, even those of the cellular kind, a natural contractibility and power of retraction, which appears equally in living and dead bodies, whether warm or cold.

Muscular fibres possess this power of retraction
along

"common directrix, being not able to confer together, nor communicate with each other, could never possibly conspire to make up one such uniform and orderly system and compages, as the body of every animal is.—It must be one and the same thing, which forms the whole, or else it could never have fallen into such an uniform order and harmony. Now that which is one and the same, acting upon several distant parts of matter, cannot be corporeal." P. 163.

"If there be a plastic nature, that acts regularly and artificially in order to ends, and according to the *best wisdom*, though itself not comprehending the reason of it, nor being clearly conscious of what it doth, then there must of necessity be a *perfect mind or intellect*, that is, a *DEITY* upon which it depends." Ib. p. 172.

along with that of irritability, which seems proper to them alone, in their living state; at least, it vanishes soon after death, and is not capable of being excited when muscles are thoroughly cold, in consequence of death.*

This property of irritability in muscular fibres, seems not only capable of being excited and regulated by means of the nerves, but is also manifestly capable of increase by nervous power: yet polypes, and perhaps some of those plants called sensitive, are highly irritable, though said to be destitute of nerves: if this assertion be sufficiently grounded, it would then seem, that irritability has no necessary dependance upon nerves, but may exist in muscular fibres without them. This property, however, in muscular fibres, in connexion with nerves, is productive of voluntary motion at the nod of the mind; and is also productive of involuntary motion, by the action of a stimulating fluid, upon the nerves spread over the internal surface of the heart and intestines; so that, though we may have animals formed without nerves, highly irritable and active, in consequence of this irritability; yet, in such animals as have the nervous and irritable systems united, the dependance of irritability upon

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* Te decisa suum, Laride, dextera querit,
Semianimesque micant digiti, ferrumque retractant.

Virg. Æn. x. 395, 396.

the nerves, in consequence of that union, seems so great, as not easily to be, even in imagination, separable from them.

What we know only with certainty is this single fact; that the nerves connect the soul and the body together: that by them the soul acts, and is acted upon: how these things are performed is entirely unknown to us, and will probably so remain, at least, till new discoveries are made in the nervous system.

Though no positive doctrine of any great importance has yet been deduced from the late researches and experiments, concerning the nature of the irritable fibres of animals and their nerves, these researches show that many things hitherto firmly believed concerning them, are merely supposititious. From the effects of stimuli on the nerves and muscular fibres, from the excited contraction bearing no proportion to, and often far exceeding, the force with which the stimulus was impressed; in fine, from the evident marks of life, and something resembling sensibility, in these contractions, it seems clear, that the origination of muscular action is not likely to be accounted for by any hydraulic law or mechanic power: and the suppositions of subtile fluids called *spirits*, flowing in nerves as canals, or of an electric aura conducted by

by them, or of vibrations like elastic strings, are not only assumed without proofs, but are all equally inapplicable, in all points to appearances, and insufficient to account for the communication of motion from the brain to the muscles.

To unfetter the mind from error, prepares it for the investigation and discovery of truth. A real conviction of the imperfection of our knowledge of the nerves, which has of late been gaining ground and acquiring strength from many laudable attempts to remove those defects, affords a happy presage that the acquisition of true and important knowledge, in this dark region of animal structure, is not far off. Yet we must remember, that science may be defective, when it is not illusory or totally false. For in the first gleams of light, and the first conceptions of truth itself, concerning subjects that border on the limits of human knowledge, difficulties will abound; and the darkness, which terminates our prospect, must necessarily cloud and obscure its confines.

Lastly, it has been objected, " That though
 " the motions of the uvea are involuntary, from
 " light affecting the eye, they are truly voluntary,
 " when it contracts in order to the distinct vision
 " of an object placed near the eye, whose minute
 " parts we want to observe accurately."

It is an excellent *maxim* laid down by Sir *Isaac Newton*, that "Conclusions drawn from experiments and observations by induction, are not to be shaken by any objections but such as are taken from experiments, or other certain truths." The distinction formed in this objection is the offspring of the school of *Stahl*, and has no support from experiment and obvious matter of fact; but seems verbal and hypothetical only. This will appear, if we consider that the uvea always dilates, when the distance of an object increases, and in an obscure light. Dilatation is the natural state of the pupil, and a faint image or weak light making but little impression upon the retina, and a strong light and near object (which always reflects a more vivid image than a distant one) making a strong impression upon it, the pupil is more contracted by the last, and less by the first. That the contractions of the pupil are never voluntary, but always arise from sensations of the retina, uniformly and involuntarily, by an invariable law, appears by experiments and diseases: and hence it is, that the pupil constantly becomes immoveable and greatly dilated, when by a gutta serena the retina becomes insensible. The great man, to whose precious stores we have been so often indebted in the course of this inquiry, has furnished experiments, which prove that the iris or uvea, like all other parts provided with nerves from Ganglions,

has

has but a dull degree of feeling, and is moved intirely independent of the will. " What persuades
 " me, that the iris is much less sensible than the
 " retina, is, that if, after having pierced the cornea,
 " you irritate or cut the iris, it is not therefore contracted; whereas the least increase of
 " light makes it contract: which evidently proves
 " that this contraction does not depend upon the
 " proper sensibility of the iris, but on the retina:
 " the gutta serena serves to prove the same thing;
 " the iris being no ways changed in that disease,
 " any farther than it is deprived of motion from
 " the sensation of the retina being destroyed by a
 " palsy of the optic nerve."* And whoever will observe the motions of the pupil by means of a mirrour, will find the will has no sort of power over them.

* See Baron Haller's Essay on Irritability, p. 31. and Element Phys. T. v. p. 374—378.

*After Having pierced the Cornea
 you irritate or cut the Iris, and it
 is not therefore contracted, but on
 exposure to light makes it contract
 which proves that the Sensibility is
 not in the Iris* ^{But in} ~~the~~ ^{the} retina

S E C T. V.

Late experiments on animal electricity: additional proofs. — Summary view, and conclusion.

IT will be expected that I notice the experiments of *Galvani*, *Volta*, *Dr. Valli*, and *Dr. Fowler*, on animal electricity, and their connection with my subject.

On the whole it appears to me, that an electrical explosion produced by the approximation of two metals, one of which is in a negative, and the other in a positive, state of electricity, conducted by the nerves, acts as a stimulus on the muscular fibres. This electrical fluid is indeed inconceivably penetrating and active; and the medullary substance of the nerves is found to be an excellent conductor of it. But still its action seems analogous to that of other extraneous stimuli, and like them to be impeded by the Ganglions.

In

In these interesting experiments, so far as they have come to my knowledge, it appears that the effects of the influence of the metals are confined to the nerves appropriated to the muscles of voluntary motion: and that the heart, through the medium of its nerves, is not excitable by the same means which are found efficacious in exciting other muscles. In this *Galvani*, *Volta*, and *Dr. Valli* agree.*

Dr. Fowler has prosecuted this inquiry with much ingenuity, and repeated, as well as varied, these experiments, with great industry: he says, "I surrounded with tin-foil the par vagum and intercostal nerves of several cows and sheep, while the auricles of their hearts were still contracting, and placed one end of a bent silver rod, at one time upon the heart itself, at another, upon adjacent muscles, and sometimes upon the nerves, but all without producing the slightest variations, in the contractions of the heart, or a renewal of them when

* See *Phil. Trans.* p. 1, — 1793. — and *Dr. Valli* on Animal Electricity.

Dr. Monro's experiments, on animal electricity, &c. which I had not read till this section was prepared for the press, clearly decide that the fluid or influence from the metals, is electrical or similar to it: that it is not the nervous fluid, but operates as a stimulus on the nerves, and by their medium only on muscular fibres. — If the involuntary muscles had been thus put in motion, notice, most probably, would have been taken of it by this accurate observer.

when they had ceased." *Fowler* on An. Elect. p. 70.

" I had as little success when I made similar experiments upon a dog, cats, rabbits, fowls, and frogs; yet in all these animals, I could in general excite vigorous contractions by arming the nerves of parts obedient to the will." (*Ibid.*)

After Mr. *Fowler* had observed the superior powers of zinc and molybdena in exciting contractions, he endeavoured to excite them in the involuntary muscles, by applying rods of zinc and silver to the nerves of the heart in frogs: and he succeeded in exciting contractions, when the metals were applied to the nerves very near the heart and after opening the pericardium, and to the heart itself taken out of the body lying upon a plate of zinc.

In these experiments the stimulus appears to have acted either on the substance of the heart, or its nerves and vessels, in a very near approach to its substance, below the Ganglions, in a manner analogous to the well-known action of chemical and mechanical stimuli, applied to that most irritable organ.

In other experiments he says, " I could not observe

serve that any contractions were produced in the stomach or intestines by placing the metals near the stomachic plexus and semilunar Ganglion in a cat."

With respect to the contraction of the iris produced simultaneously with the flash of light by the union of metals; that flash is excited in positions of the metals so various, on the lips, face, and nostrils, that there seems no ground for concluding that the effect of the contact of the metals passes through the lenticular Ganglion, to the retina, considering the diffusive penetrating nature of the electric fluid, and that there are so many other nerves and means of conducting of it: particularly when it is remembered, that mere rubbing in the dark, and pressing the globe of the eye, and the parts contiguous to it, cause a similar sensation of light; and that, by an established and invariable association, the iris always contracts from the sensation of light, from whatever cause it may be excited.

Those who candidly make truth the object of their pursuit, will see in these experiments new support to the doctrines of this Essay, and in it a clue to explain these experiments, and the consequences deducible from them, in which they are in harmony with other physiological facts.

If

If the subtle electric fluid, for such it appears to me, had, in these experiments, really passed through the Ganglions, and produced contractions in the involuntary muscles, conclusions drawn from anatomical and physiological facts, that these muscles are rendered involuntary by intervening ganglia, would not have been thereby invalidated. But on the contrary, as voluntary muscles only are susceptible of contractions, by the application of the two different metals to their proper nerves, it seems reasonable to conclude, that the mechanism in Ganglions, by which volitions are interrupted, also prevents the influence of the two metals, as it does other stimuli, applied above the Ganglions, from exciting contractions in the involuntary muscles: and when stimuli, or, those metals are applied below Ganglions, and immediately touch these involuntary muscles, or the nervous matter intimately commixed with their fibres, they being highly irritable, contractions will be excited and renewed in them at pleasure.

Dr. *Valli* finds ligatures on the nerves, interrupt the communication of the electric influence to the muscles: and also that the fluid has much less affinity to the coats of the nerves, than to their medullary substance; and that it is principally conducted, by the proper nervous substance, to the corresponding muscular fibres.

As

As in Ganglions the nervous substance appears to be intimately intangled in cellular substance greatly indurated, does not this structure, though imperfectly understood, shew how the electric influence is interrupted in Ganglions, and suggest, by the analogy of ligatures, the means which interrupt volitions, from acting upon the involuntary muscles?

These unsought and accidental proofs of my opinion, make it in no small degree probable, that no real advance will hereafter be made, in the physiology of the nerves, which will not in one respect, or another, confirm our doctrine.

On the whole, whether we consider the functions of the parts, on whose nerves the Ganglions are constantly seated, or that of those which are destitute of them, whether we consider what has been advanced in favour of our doctrine on the uses of the Ganglions, or what with equal impartiality we have stated as having been objected to it, by ingenious and learned persons, there results a surplus and preponderance of evidence and argument, clearly evincing that the internal motions, of the principal organs of life, are involuntary, by the means of the Ganglions seated on the nerves distributed to them.

I add

I add to this summary view, the following extract from a paper, which the ingenious author permits me to insert in my work. The argument being compressed into a narrow compass, and expressed with equal clearness, and force in it, will leave its impression with my readers.

“ It is known that the nerves are the instruments of sensation and motion, by their constant distribution to the organs of sensation and motion : in like manner the Ganglions constantly attending the nerves distributed to the organs of involuntary motion, and, in a more accurate anatomy of the nerves, not being found on nerves appropriated to sensation and voluntary motion. It follows by induction, that they are thence ascertained to be the means by which the involuntary motions are independent of the will, with the same kind and force of evidence, nerves without Ganglions, are known to be the instruments of sensation and voluntary motion.

“ The importance of this discovery was felt by *B. Haller*, and other anatomists, but was treated with some degree of that jealousy, with which discoveries in anatomy are generally received : objections have been repeated, which were obviated in *Dr. Johnstone's Essay*. The Ganglion, as it has been erroneously called, of the fifth pair was objected :

GANGLIONS OF THE NERVES. 63

jected: but *Wrisberg*, in his work *de quinto pari*, demonstrated that, to be no Ganglion, as in fact it evidently is not.

“ The Ganglions on the spinal nerves were also objected. Dr. *Monro* demonstrates that half of each of these nerves, does not pass through, but slips on one side, of the spinal Ganglions. This removed the only difficulty, the only objection of force to this great discovery, and ought to have made Dr. *Monro* a convert to it; but anatomical prejudice is not easily overcome.

“ As the ultimate structure of a nerve is unknown, so that of a Ganglion is not sufficiently unravelled to explain *how* it checks the operations of the mind. — The doctrine therefore rests upon no hypothesis, and is not affected by any thing advanced on the structure of the Ganglions by *Monro*, *Meckel*, *Zinn*, and lately by *Haasse*, as stated by the very learned *Tiffot*; (see his *Analyfis of Dr. Johnstone's Essay, Traite' des nerfs et de leurs Maladies*, T. 1.) but has received, since it was first published, confirmation and additional evidence by its agreement with the anatomical figures and descriptions of *Wrisberg*, *Neubaver*, *Monro*, and *Walther* of Berlin: and hereafter it will be considered by posterity as one important step made in the knowledge

knowledge of the nerves, after an interval of two thousand years since they were first known to be the instruments of sensation and motion."

S E C T. VI.

Some diseases considered briefly with relation to

Ganglions.

FROM what has been said, I think it appears, that Ganglions are organic parts of great importance in the nervous system, and animal machine. That they limit the powers of volition, will, I flatter myself, appear a doctrine fairly inferred, by an induction, little, if at all, short of being complete. We may therefore venture, upon these grounds, to consider some of the subordinate effects of Ganglions in our machine; some of which we have already hinted, and which, I doubt not, will be much more extended by those who shall succeed me in this research: the coast is discovered, and others, I hope, will gather its riches.

I have already had occasion, in answer to an objection stated in Sect. IV. of this work, to prove that parts supplied by the sympathetic nerves, have in general an unprecise, dull feeling, and appear

F insensible

insensible in many important circumstances of the animal œconomy. We have no conscious perception of the stimulus of the heart, from the blood received into its auricles and ventricles, and none of that, which is going on in the intestines, and the organs of secretion. *Haller* and his scholars, in an immense number of experiments, prove incontestably the insensibility of the internal organs whose nerves have Ganglions. He even transiently says, "Ab ea unione (in Gangliis) nonnunquam suspicatus sum, ut anima non adeo accurate locum dolentem distinguat, sed obiter utcunque et aliqua latitudine." *El. Phys. T. iv. p. 408.—4to.* This most industrious physiologist, in his Essay on the sensible and irritable parts of animals, speaking from experiments he tried, which also were repeated and confirmed by his scholars, has the following facts, which are so many proofs of my assertion.

"The heart, which is very irritable, has, he asserts, but a small share of sensation, and, upon touching it in a living person a fainting is occasioned, rather than pain properly so called.

The stomach is sensible, the intestines much less so, and are not liable to such violent pain, and yet they are more irritable.

We

We must not conclude that a part is sensible, because it is irritable, for the cutting and tying of a nerve, which destroys the sensibility of that part to which it is sent, does by no means destroy its irritability.

"I divide the phrenic nerve, and irritate that section, which does not communicate with the brain, and has no sensation left, the diaphragm nevertheless is convulsed.

In the same manner by cutting the crural nerve of a dog, that limb is deprived of sensation; but if you irritate that part of the nerve which communicates with the muscles of the leg, that leg so irritated, will be put into a trembling motion, demonstrating the irritability of its muscles."

Our illustrious author might very conclusively have added, that the experiment likewise proves, that the property of *irritability* depends upon the nerves distributed to the muscles. But he had adopted the false principle, that it depended upon a *vis insita* in muscular fibres, and not upon the nervous matter ever present with them: I go on with our author's facts.

"I am fully convinced, from a great number of experiments, that the viscera properly so called,

viz. the lungs, liver, spleen, and kidneys, have very little sensation, seeing I have irritated them, thrust a knife into them, and cut them in pieces, without the animals seeming to feel any pain. Hence ulcers in the lungs are not attended with any pain, and persons have had stones in their kidneys for several years, without being sensible of pain from them.

“The glands in general have only an obtuse sensation; hence scirrhus and incysted tumours are so indolent.

“If you cut or irritate the iris, it is not thereby contracted, the increase of light alone makes it contract, by its stimulus on the retina. The iris is no way changed in the gutta serena, and is only deprived of motion, from the sensation of the retina being lost by a palsy of the optic nerve. In the operation of couching for the cataract, the patient hardly feels the instrument, after the tunica conjunctiva and cornea are pierced through.

“It is almost needless here to add, our author's conclusion, that irritability takes place in the body, without the soul being sensible of it, and that it is not subject to the command of the will. For it may be excited after the head, the seat of the soul,

is

is cut off, and after the heart, intestines, and muscles are separated from the body."

The following observations, which are more properly nosological, prove also that parts, whose nerves are insulated from the brain by Ganglia, are to a considerable degree insensible, and, are always indeterminate in the sensations excited in them, even by stimuli of extraordinary force.

The celebrated *Harvey*, ex. 52. de Gen. An. gives the history of a large wound in the left breast of a young nobleman, which laid bare the point of the heart. In touching it, he was convinced of the insensibility of the heart. Some attempt to explain away this fact, by alledging the heart was hindered from feeling in this instance, by the membrane which covered it: *Harvey* had sufficient discernment to have made the distinction, if there had been any foundation for it; and it may be observed, that a glove on the hand, a shoe, or the cloathing of any sensible part, does not make it insensible to pressure, as the heart is supposed in this case to have been.

In consequence of this insensibility, the most formidable diseases lurk undiscovered in the heart, and either slowly or suddenly destroy life: and are only known by dissections, to have had their prin-

cipal seat in the heart. This appears in a vast number of observations, for which I refer the critical enquirer to *Bonetus*, and the later anatomical collections of *Morgagni*, *Lieutaud*, *Dr. Baillie*, and others.

Boerhaave was well acquainted with this fact, as well as some of the older physicians quoted by *V. Swieten*, Sect. 913; but the following paragraph is taken from *Boerhaave's prælectiones de morbis nervorum*, p. 496. Nec etiam fit dolor, in nervis cardiacis vel hepaticis; nam observatum est a medicis, quod cor in febribus summis inflammetur, & quod æger moriatur, & tamen inde nullus fit dolor; sentitur quidem *anxietas*, fidelis ille periculi nuncius, omni molimine agens, ut non fiat mors; *sed non dolor*. Quando pulmo exeditur, vel hepar, vel ren consumitur, nullus etiam dolor; sed quando membranæ horum viscerum ab inflammatione afficiuntur, statim fit dolor immanis, *Ergo omnes partes nervosæ non sentiunt*, tamen hic nervi sunt; sed nervi qui a pare octavo, ab intercostali, a recurrente, a medulla spinali ad cor tendunt; in toto itinere quidem sentiunt, *non vero in corde*; nam omnis musculus delassatus sentitur, sed cor, quod semper agit, nunquam delassatur, nunquam dolet.

Boerhaave was well acquainted with the insensibility

bility of the heart and other viscera supplied by the great sympathetic nerves; but did not know that the Ganglia on those nerves occasioned that insensibility.

In two memorable cases recorded in 14 vol. Rat. Medendi of *De Haen*: both patients had the difficult respiration, and those pleuritic pains which generally attend the peripneumony; yet in the dissection of the first patient, the lungs were found inflamed and purulent, the *pleura* very much inflamed, the *pericardium* inflamed and thickened, the *heart* covered with that pellicle which is usually found on inflamed parts, the substance of the heart *enormously inflamed*, *purulent water* in the cavity of the *chest* and *pericardium*.

In the second case, all these parts were *inflamed*, the lungs, *pleura*, and *pericardium*; the substance of the *heart* itself was pale, and had no appearance of inflammation, though covered with a pellicle, which probably arose from inflammation of the *pericardium*.

In these cases it was evident an inflammation of the heart furnished no pathognomonic symptoms: Dr. *Cullen* therefore very justly says, carditis gives no symptoms different from those of peripneumony, with which it appears often to be complicated.

The celebrated *Carolus Piso*, *Charles le Pois*, who wrote an excellent treatise on the diseases of the nerves, though its title be, *de Colluvie Serosa*. In his Sect. 3. C. 2. treating of palpitation of the heart——Observed in dissection, the cause of palpitation and difficult breathing was occasioned by the pericardium being distended and filled with several pints of water. Nor is it to be wondered, says he, that the pericardium should “*sensim & sine sensu*,” be gradually so much distended in that patient, as he before observed in another, *Elizabeth Bordes*, “*Membranam Renis in eam amplificatam longitudinem quæ universam abdominis capacitatem, servata tamen figura exacte, coæquaret, et quatuordecem libras puris, exeso, scilicet parenchymate & suppurato, contineret, nec ab eo pondere per aliquot annos continuitatem amisset*.” *C. Piso*, *De morbis a Colluvie Serosa*.

If we except some few instances of diseases attended with acute pain in the stomach, in the ureters, and gall ducts, from *Calculi*; inflammatory diseases in which the pleura, and external membrane of the liver are affected; we can very seldom determine from pain alone, the precise part, affected principally in internal diseases: and notwithstanding the excellent rules in *Galen*, *de locis effectis*, and the assistance of a more accurate anatomy and an advanced physiology, we are obliged to infer it,
from

from a nice, and frequently very precarious, induction.

Diseases in the mesentery, pancreas, spleen, kidneys, and parenchyma of the liver, very frequently elude the discernment of the ablest practitioners in medicine, and are only discovered after death by dissection.

To the Ganglions seated, on these and other parts, having nerves supplied with them, it must be owing, that sensation does not conduct us with the most pointed precision to the parts affected by painful irritation: and direct to the immediate seat of an internal disease, as exactly and pointedly as we feel the seat of an external wound, or inflammation: or, as we feel a fit of the gout, of the tooth-ache, a pain at the stomach, a pleurisy, or a quinsy.

We ought, without some essential difference in the nerves, which convey sensations, to feel the point of a needle in the gut, as surely as we feel it, when it pricks the finger; but the following observations inform us differently.

In May, 1773, I attended a person who had given himself a wound in the abdomen, from which a part of the intestinum ileum, which was
opened,

opened, hung out of the body. At a time when the wound was recent, the gut not mortified, and the patient very sensible, he felt nothing; and was insensible of the needle being passed through the gut in stitching it up: nor did he feel the least smart some days after, when the same wounded intestine, was touched with spirit of wine, or know, when I touched a sound part of the gut with my finger; though he was very sensible when I touched any part of his skin.

In September, 1786, I had an opportunity, in our Infirmary, of repeating this observation, on one *Hughes*, who had one of the intestines laid bare by an ulcer, which penetrated through the integuments of the abdomen, and made a small opening in one of the intestines. She did not feel, when a finger or probe touched the intestine, nor any smart when tinct. myrrh was applied to it; but when the integuments were touched with it, the smarting was quickly and decidedly perceived. A proof that ordinary sensation, is as much wanting in these parts, where most painful diseases are nevertheless often seated, as we have before shewn it to be wanting in the heart.

But this point, so important in the diagnostic of internal diseases, seems sufficiently ascertained, without

without additional proof, to call the attention of practical physicians to it in future.

In sleep, and in apoplexies, the external senses cease to convey impressions to the soul; and the exercise of voluntary motion is superseded; but the vital functions have in these circumstances the same, and some have believed, a greater strength and vigour than before: the truth seems to be, that what is wanting in the frequency and number of respirations and of pulses, is made up by their greater deepness and fulness. In sleep, this temporary interruption of sensation and voluntary motion, arises from the nervous power being exhausted, which by a few hours rest is constantly recruited; and with it, a state of vigilancy returns, in which the whole animal machine, its senses, voluntary, as well as involuntary motions, are in complete action.

Apoplexies arise from some extravasated fluid, or other cause, compressing the brain in such a degree, as to put an end to its functions, (if not removed,) and those of external sensation and voluntary motion, depending upon them.

It has been a question long agitated, why in apoplexies, the same compression does not intercept the nervous power, by which the *vital* functions,
and

and *animal* functions are both supported : and how it happens, the heart continues to move, and the respiratory organs to act, for a considerable time after sense and motion in the other parts seem to be at an end.

Some eminent physicians have attempted to solve this question, by confining the cause of apoplexies to the brain only, from whence they supposed all the sensory nerves, and those subservient to voluntary motion, were derived : and that the cerebellum remained uncompress'd, because of the strong and tense membranes, which are interpos'd betwixt it and the brain ; and, that the vital organs from thence were solely supplied with nerves : (which is far from being true :) and this they imagined, proved by some experiments, in which wounds of the cerebellum, were found to occasion immediate death in various animals.

But it being observed by others, that the worst wounds of the cerebellum had sometimes healed, and that not much difference, as to danger, could be observed, betwixt deep wounds of the cerebrum and cerebellum : and that foetus's at their full time have been born alive, though destitute both of brain and cerebellum : and lately it having been found that the spinal marrow may be cut through near its origin, and the eighth pair, and great sympathetic

sympathetic nerves divided, by which all communication both with the brain and cerebellum is cut off, yet, to the astonishment of beholders, the heart continuing to move for many hours afterwards, this theory falls of course; and we are obliged to search out some other cause, which may account for this phenomenon, in a more satisfactory manner.

I am not without hopes, that the doctrine we have advanced concerning the nature and uses of Ganglions of the great sympathetic nerves, will afford a natural solution of this difficult problem. The great sympathetic nerves being truly derived from the spinal marrow, have in the numerous Ganglions proper to them, so many receptacles of nervous energy, so many subordinate brains, which continue to dispense the nervous energy to the vital organs, long after they cease to have communication with the brain; and support the *irritability* of the heart, *which* makes it so long sensible to the stimulus of the blood flowing into its auricles and ventricles, after the rest of the machine is in fact dead: but, as the whole nervous system derives its energy from, and ultimately depends upon, the brain and cerebellum, these subordinate sources of nervous energy, being at length exhausted, without a possibility of a new afflux from the brain, the vital organs at length cease to move.

This

This reasoning seems strongly confirmed by those *foetus's* already mentioned, which come into the world without any brain or cerebellum: these generally have the *medulla spinalis* large enough to supply the great sympathetic nerves: and by these nerves, the force of the heart, the circulation, and developement of the organs of the *foetus*, are sustained in the mother's womb; for such *foetus* die, as soon as they lose the mother's fostering heat, if not dead before their birth.

By the inter-communion of nervous energy arising from the numbers of Ganglions on the great sympathetic nerves, we understand also how, and by what means, the vital and involuntary powers of our machine, go on unimpaired in perfect hemiplegias, which reduce one half of the animal body to a state of mere vegetative life, the muscles of one side being no longer obedient to the will: when this is thoroughly considered, it will be found a strong proof of our doctrine: for if the filaments of the nerves were not interrupted by, and intermixed in, Ganglions, in their course from the brain to the viscera, but were continued threads or substance, as they are from the brain to the sensory organs, and voluntary muscles, a very manifest defect must have appeared in the functions of the viscera contained in the thorax and abdomen, by the loss of half the nervous power distributed to them:

them: that is, a greater defect must have happened in every hemiplegia, than ever happens in any one.

It seems consistent with this view of Ganglions, as subordinate origins of nerves sent to the intestines, yet, ultimately derived from the brain; rendering sensations less determinate, yet, not precluding them in an indistinct way from reaching the sensorium commune: it is, I say, natural to expect from, and consistent with this doctrine, that such causes as very considerably compress the whole brain, or spinal marrow near the head, so as to intercept external sensation, will also blunt very considerably the sensation, and lessen the irritability, of the parts to which the intercostal nerves are distributed: this indeed actually happens in dangerous attacks of the apoplexy, in which the most irritating medicines, the most violent and stimulating cathartics, in doses, which at other times would be poisonous, are often inert and ineffectual, from the unfeeling state of the intestines: this also happens when the spinal marrow near the head is greatly compressed, of which we have a curious instance in the last volume of London medical observations.* But in other cases, where I have known

* See Medical Observations by a Society in London, Vol. iii, Art. xviii, p. 160. and M. Du Verney's observation in Reg. Scient. Acad. Hist. Lib. iii. De Hanel, p. 264. We have also curious instances of the same kind

known the spinal marrow compressed, though less considerably, and at a greater distance from the brain, this effect has not followed: when that total compression is but a little removed, and the nerves of one side only, as in the hemiplegia, or perhaps still fewer than half the nerves, pass down the spine free from pressure, then the intestines *altogether* recover their sensibility, and the heart continues to act with its wonted vigour; by which we know, that by some communication of the nerves in Ganglions, analogous perhaps to an anastomosis, the functions of the viscera are carried on sufficiently.

I might go on, to confirm the reality of such a communication of nerves in Ganglions, as is above suggested, by various phænomena in other diseases, which plainly point it out; and to account for the production

kind in the very useful and interesting inquiry into the efficacy of warm bathing in palfies, by the ingenious Dr. Charlton. — *John Waterman*, aged thirty-four, by a fall, had the third and fourth vertebrae of his neck distorted. The paralytic effects of this distortion, which remained when he was admitted into the Bath hospital, and which were soon removed by pumping upon the neck, (the vertebrae gradually sliding back into their natural situation,) were, a palsy in his lower limbs, and a monstrous distension of his belly, which was sore to the touch, and if struck on, sounded like a drum; he was costive, and it was with the utmost difficulty he parted with his urine. The swelling of the belly subsided by great discharges of wind from the stomach, and in proportion to its decrease, the action of the bladder and the peristaltic motion of the bowels were restored, with the perfect use and feeling of his limbs, p. 58. See also *Mrs. Whitty's* case, *ibid*, p. 31. See also note in Section third of this Essay.

production of sympathy, in many cases, in consequence of that connexion. I might also show, that Ganglions probably have some use in secretion, by securing a more uniform motion of the liquors in the secreting organs : as it is certain that the visceral glands, and even the testes, are universally supplied with nerves from the great sympathetic stock, and that the salivary glands have nerves from the small branches of the fifth pair of nerves, on which Ganglia have been found by *Mekelius* and *Haller*. (See Sect. 111.) It is highly probable that Ganglions have some important use in secretion. That by giving a check to the ordinary powers of the mind, the energy of the nervous influence is appropriated wholly to the operation of secretion, and a more uniform motion of the liquors secured in the secreting organs. This is the more likely, as it is well known, that the secretions are much affected and disturbed by passion, or any extraordinary movement of the mind.

I do not attempt to explain the mystery of secretion ; but it has been, I think, well observed, that the whole intestinal canal, is really a gland, that the lacteals are its ducts, which carry off the secreted and digested liquors : that all other glands are analogous to it. — Indeed the functions of this tube, and the power of digestion, have an analogy so obvious to glandular secretion in general, that

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much

much light is thereby thrown upon it; when it is considered that all the glandular internal viscera derive nerves from Ganglia, and, that the intestinal tube is so furnished; that the peristaltic, and involuntary motions of the intestinal tube, are excited by the unperceived stimuli of the bile, and other digestive liquors, as well as of ingesta and air. In like manner the secreting organs are actuated by the stimulus of their contained liquors alone. These liquors or fluids, seem separated in each gland, for the purpose of preparing the specific fluid to be secreted therein, in a manner similar to the gastric liquor, which is prepared in the stomach and intestines for the purpose of digestion. If the stomach has by this means, its proper assimilating digesting power, which in some circumstances devours and digests its own substance, why may not each gland, likewise possess its specific assimilating power, its digesting fluid, by which it produces its peculiar secreted liquor, and no other?

— But I leave the prosecution of this hint to others, as such discussions as these would lead me into a very wide and uncertain field of physiological disputation: it would be more my inclination, by pursuing the same clue of obvious facts and experiments, to try to make some advances in the knowledge of nervous diseases, which being so near the seat of the mind itself, afflict it more sensibly than those which affect the nerves less, and
are

are thereby more remote from the mind: changeable besides, and intricate in themselves, they seem to have been rendered more so, by the wild and hypothetical manner in which they have been for the most part considered. The most precious truths, even on that subject, may be more within our reach than we are aware of, provided we adhere close to the method of observation in our researches, and carefully divest ourselves of prejudices arising from received theories, which, involving the mind as in a mist, render it less apt to perceive and admit the truth: but I leave this exquisite task to those who have abilities proportioned to its importance; to the *Hallers* and *Tiffots* of this, and the *Boerhaaves* and *Whytts* of succeeding ages.*

————— *Nec meus audet*

Rem tentare pudor, quam vires ferre recusent.

I shall therefore now finish this Essay with a recapitulation of the principal matters endeavoured to be proved in it; and with reflections not unsuitable to my subject.

* Dr. *Tiffot* has already published a considerable part of a very important work on the diseases of the nerves; and the medical world expects with impatience the remainder of a design, which does equal credit to the comprehensive learning and ability of the ingenious author.

S E C T. VII.

Now heav'n in all her glory shone, and roll'd
 Her motions, as the great first Mover's hand
 First wheel'd their course; earth in her rich attire
 Consummate lovely smil'd; air, water, earth,
 By fowl, fish, beast, was flown, was swum, was walk'd
 Frequent; and of the sixth day yet remain'd;
 There wanted yet the master work, the end
 Of all yet done; a creature who not prone
 And brute as other creatures, but endu'd
 With sanctity of reason, might erect
 His stature, and upright with front serene
 Govern the rest, self-knowing, and from thence
 Magnanimous to correspond with heaven,
 But grateful to acknowledge whence his good
 Descends, thither with heart and voice and eyes
 Directed in devotion, to adore
 And worship God supreme, who made him chief
 Of all his works.

PAR. LOST, B. vii.

*Recapitulation. — Final cause of our vital motions
 being involuntary.*

THE Ganglions, respecting their structure,
 may justly be considered as little brains, or
 germes, of the nerves detached from them, con-
 sisting

sisting of a mixture of cortical and nervous medullary substance, nourished by several small blood vessels, in which various nervous filaments are collected, and in them lose their rectilinear parallel direction, so that a new nervous organization probably takes place in them.

Respecting their uses, Ganglions seem the sources, or immediate origins of the nerves, sent to organs moved involuntarily; and probably, the check or cause, which hinders our volitions from extending to them.

Ganglions seem analogous to the brain in their office: subordinate springs, and reservoirs of nervous power, they seem capable of dispensing it, long after all communication with the brain is cut off. And though they ultimately depend upon the brain for its emanations, it appears from facts, that, *that* dependance is far from being immediate and instantaneous.

From the Ganglions serving as subordinate brains, it is, that the vital organs derive their nervous power, and continue to move during sleep: and, to the same cause, as well as to its greater irritability, we may refer the continuance of the motion of the heart, so much longer than that of the voluntary muscles, in perfect apoplexies.

From thence too, the motions of the heart receive for some time, support, even after the spinal marrow and the intercostals, in their descent along the neck, are cut through: so that animals survive this experiment sometimes thirty hours, which however proves at length certainly fatal, by cutting off all communication with the prime fountain of nervous emanation.

In a word, *Ganglions* limit the exercise of the soul's authority in the animal œconomy, and put it out of our power, by a single *volition*, to stop the motions of our heart; and in one capricious instant, irrevocably to end our lives.

However in the dark we may be, what subordinate agents are employed by an *Almighty arm*, to wind up and regulate this delicate machine, so uniformly to guide and direct, independant of us, our vital and involuntary motions, we must at least clearly discern the goodness, and unerring wisdom of our CREATOR, acting therein, though by ways past finding out, for our preservation and security.

Being thus led up to this exalted truth, the natural and happy fruit of my subject, I hope to be excused expressing more at large (though still in a very summary, and imperfect manner,) my sense of it, and in giving a cursory glance, at the *final cause* of a contrivance by which we live.

Researches

Researches carried far into nature, constantly lead us to traces of an all-governing DEITY, exercising a sovereign authority over HIS works. The motions of the largest masses, and most minute particles of matter, all performed with the same order and ease, and regulated by laws surprisingly simple and extensive, penetrating the inmost recesses of bodies, and extended throughout the *universe*, evince the direction of an omnipotent Almighty Power, actuating the whole.

In every part and operation of nature, the fitness of things to one another, and *one design*, and their subserviency to the best ends, and to the use and felicity of intelligent beings, point out the consummate wisdom and goodness of *One great Artificer, One original Mind*.

The *course of nature* is undoubtedly the effect of the incessant direction of the DEITY, no less than its creation and original arrangement: it seems impossible, and incomprehensible, that any mechanical power, any organization of mere matter, could of itself, without direction or art, produce vegetables and animals, all machines of exquisite construction, at all times and every where arising into being in amazing profusion: tasteful life, and by an established order, made instinctive and blind instruments to bestow it on others, and then re-

tiring from this stage of existence after a short appearance upon it. But

————— “ *The universal Cause
Acts not by partial, but by general laws.*”

By such laws originally established to secure the uniformity of nature, the constancy of cause and effect, and the permanency of species, God directs the successive *evolutions* of the animal and vegetable tribes. The verdure of the field, and all its flowery plants, the humble shrubs, and the lofty trees, in infinite variety, are his constant care, as well as his bounteous gift. Sole giver of life, He inspirits with animation the meanest insect, and most abject reptile, no less than the more perfect and nobler animals, and by His wisdom guides them all to the several ends of their existence.*

Every thing, in fine, on earth and in the heavens,

* This is a truth deduced from the most profound examinations into nature, as well as apparent from a superficial survey of it, and agreeable to common sense,

’Tis a truth proved and confirmed by the discoveries of a *Haller* and a *Bonnet*, as well as by the researches of the ablest interpreters of nature in all former times. By those of *Aristotle*, *Cicero*, *Galen*, *Bacon*, *Boyle*, *Newton*, *M’Laurin*, who concur in demonstrating that the last link in the chain of natural causes terminates at the throne of GOD.

In vain have various persons endeavoured to give a satisfactory account
of

veris, manifests and presents him to us; and in the wonders of the lowest, as well as the most magnificent of His works, the understanding with transport traces the perfections of a CREATOR, who is not far from every one of us, and in whom we live, move, and have our being; sees his fingers touching the keys of nature, producing harmony in the universe; and his omnipotent arm unwearied for so many ages sustaining, conducting every thing.

But we ourselves are an abridgement of the universe, and, with reverence be it spoke, contain within us the image of its CREATOR; and were it possible not to trace HIM in that vast theatre where he

of the origin of organized bodies, by any mere mechanical operation: as easily might we conceive a watch capable of producing its like without a maker. The efforts of a modern writer of great genius, in favour of this cause, have not given more satisfaction than those of *Democritus* and *Descartes* formerly gave. Happy in overturning the false system of generation founded on the observations of *Leewenhoeck*, he has built upon its ruins one, no less imaginary, and in all respects more exceptionable.

The microscope, indeed, discovers to us, not only in the *feminal liquors* of animals of both sexes, but also in infusions of all kinds of animal and vegetable matter, *animalcules* small and various beyond all conception, but still possessing every characteristic of a living and complete animal.

Though these animalcules are over-rated in the *Leewenhoeckian* system of generation, they are under-valued in that of *De Buffon*, and have, like *ignes fatui*, led both into mistakes.

To call these microscopic animals, particles of mere unorganized matter,
self-

He exercises His power and wisdom with such magnificence, we might nevertheless contemplate His Being and Attributes displayed in our structure, and exercised in our preservation.

The mechanism of our body, the connexion and subserviency of all its parts to a common purpose, the exquisite contrivance of its organs, consisting of all the various orders of vessels, interwoven with wonderful art, have led anatomists in all ages to acknowledge an infinitely wise and powerful Maker. Among the most precious remains of antiquity, are those commentaries of *Galen*, wrote on the uses of the parts of the human body, as hymns and offerings of praise to our great CREA-

TOR.

self-moved, and self-active — organic particles, unorganized, but tending into organization, & une matiere vivante, is a prodigious petitio principii, and abuse of language.

But still, in order to evade the acknowledgement of art in the formation of animals, it is said, these organic particles are determined to this or that shape, are organized, by means of animal moulds: this is still assuming what is destitute of proof, and saying what cannot be conceived or understood, if any thing else is thereby meant besides the assimilating power of a body already formed. In any other sense, moulds capable of forming machines so complete, so astonishing, of imparting form, external and internal, order, connexion, motion, life, with such amazing exactness and propriety, in machines consisting of such a prodigious variety of parts, would be more wonderful than the machines themselves: they explain nothing, and instead of showing how animals may be made without art, they suppose a higher exertion of it; but an exertion passing all comprehension: and this celebrated modern system, with all the embellishments

TOR. Is it, indeed, otherwise conceivable how such consistency and harmony could have taken place in the different parts of our wonderful frame? How they could have been so exactly fitted to each other, and to the exterior objects, which have an evident relation to them, and the system they compose? Could the bones and muscles have been so well disposed for motion, without a superior knowledge in mechanics? The eye so admirably adapted to admit light and appropriated to vision, was it formed without a knowledge of optics? Or the ear, without the science of sounds? To attribute contrivances like these, and even understanding itself, to unintelligent causes, rather than to the all-wise Parent of nature, seems an incomprehensible perversion of reason and philosophy.

From

bellishments of eloquence, and ornaments of language, has [not the credibility even of a romance.

The *vital* and essential parts of animals could not have subsisted *separately*, or been produced one after another, but must have been one coeval system, formed at once, and connected together previous to what is called *generation*, which is, in fact, only the occasion of the growth and increase of these rudiments of a nervous and vascular system in bulk and strength, and into such parts, as are capable of shooting and vegetating from them.

If it be admitted as essential to animal life, that the heart should receive its nervous influence from the brain, and the brain its nourishing blood, and the liquor it is to separate for the use of the nerves and the purposes of muscular motion and sensation, from the arteries; and, that a
part

From the curious structure of our bodies, we infer the wisdom and power of our Maker; but in the constitution and operation of our rational soul's, man's noblest part, and true essence, the image of God is impressed and delineated, and His government of the universe exemplified; more especially in the conscious exercise of that power, by which we, as free agents, are capable of exciting an infinite variety of movements in our bodies; all of them depending upon, and regulated by our volitions; while others go on with a seeming spontaneity and independance, and begin and end only with life itself.

Even our inclinations and passions, those sources of so much apparent ill, are, by the DEITY, providentially rendered the means of our preservation both

part of these fluids should again return to the heart by the veins; it is easy to perceive that in the generation of animals, a heart and a brain, and their communicating vessels, and mutual dependencies, could never be produced at all, much less produced at once, by the circulation of the different liquors of the parent animal in their proper vessels, or by any alteration these liquors undergo in the *organs of secretion or of generation*: and that the production of an animal, is a work not to be effected by matter and motion alone, and is superior to all mere mechanical means.

Good observations and just reasonings lead us to conclude, that all plants and all animals whatsoever, in their seminal state, are pre-formed, and that their essential parts exist in miniature; but in a dormant and inactive state, very different from that of *microscopic animalcules*, or moving particles seen by the aid of *microscopes*.

Fecundation

as individuals and as a race: and an instinctive affection for these ends and those means, powerfully operate upon us, and like two different powers acting in one direction, conduct us with redoubled force to the ends intended by our Maker to be produced by them. These important ends are always less secured by our instinctive love of life, fear of death, and natural desire of progeny, than by the more vehement appetites and instincts, which allure us to the exercise of certain faculties more immediately as gratifications, than as the efficient means, which by experience are known to fulfil the

Fecundation puts this germinating principle, this *bud of being*, peculiar to every species, into life and action. The male sperm stimulates the little heart, and rouses it into motion, and gives occasion to a circulation of liquors in organs prepared for it, but till then at rest; it is thus the means of nourishing, enlarging, and unfolding what already existed, what was already formed and created, but creates nothing. Creation is the work of God alone. He is *our* true Father, and all plants and animals which are, have been, or shall be upon the earth, are indeed the immediate productions of His hand.

If it be found impossible to account for the re-production of animals by equivocal generation, or by any mere mechanical operation; and, in order to obtain some tolerable comprehension of this great mysterious work, we must have recourse to superintending intelligence, and refer the generation, as well as formation of animals, to the art and power of God: I see no reason why, to the exclusion of the same active principle, we should very anxiously seek to refer the involuntary and vital motions of animals, to mechanical causes alone, or to any other than to their original Mover; especially when we consider that these motions seem designedly withheld from the volitions of our own minds, and that, unconscious of them, we neither deliberate concerning them, nor ever find them obedient to the authority of our will.

The

the purposes of nature : and these instincts have in common with every spring of action infixed in our frame, a strength and impetuosity capable of carrying us too far, the more certainly to secure their efficacy as incitements to the great ends of animal life.

Yet, the love of life and all its enjoyments, and the fear of death and all its dreaded harbingers, would have been but insufficient securities for our carrying on the vital motions, with that constancy and uniformity necessary to the preservation of life, if these motions had depended on our will and choice. Reason would have deliberated concerning them with too much slowness, and volition would have executed them with a dangerous and fatal caprice. For, if the heart had been subjected to the soul's authority as much as the voluntary muscles

The many unsuccessful attempts of ingenious physicians to account for these motions on the principles of mere mechanism, should convince us of the vanity of such attempts, and that they labour under some insuperable difficulty. Nor can the doctrine of *Stahl*, who refers all these motions to our soul, be admitted, till the adherents of his sect inform us, when the soul first began to be clothed with body, and assumed the direction of its œconomy, and operations, of which, after all our researches, we remain so ignorant; when it first ventured to let the heart pant, and imparted motion to the vital parts; and when it exercised the power of suspending and renewing these motions: till, I say, we are better satisfied in all these particulars, it will be most rational, as well as decent, to refer the carrying on, and direction of, the vital and involuntary motions of animals, with their formation, to the *DEITY*, by whom, indeed, we are fearfully and wonderfully made and preserved.

muscles are, if its motions could have been suspended, or stopt with the same facility, death would then have cost us no painful pang: and, whenever the body was tortured by pain and disease, or the mind in anguish from grief or disappointment, a remedy so easy to be applied, (an escape from all *present* misery, made by the very act, and in the instant, of choice,) would have been recurred to with a dreadful frequency. Death, no longer armed with pain and terror, would in a short time have extirpated the human race.

The preservation therefore, and security of life in every moment of it, depends upon our vital motions being entirely subject to the wise government of the Author of our lives; who charges HIMSELF with the immediate care of them, and of us.

All this, when attentively considered, must affect us with a sense of God's goodness; *who*, tenderly respecting the imbecility of man's nature, hath been pleased by appetites and passions, to excite him to acts of self-preservation; and where the violence of these might have been hurtful, no less than the slowness and instability of reason, hath taken our safety under his own more immediate direction.

That

That mind must be strangely prepossessed and bewildered with false science, which rather seeks for the cause of these involuntary motions in dead matter, organization, chance, necessity, something that without knowledge or power, acts wisely and powerfully, than in the great fountain of *Power, Wisdom, and Animation.*

Unless to such, this field of study, (to use the words of an elegant writer,*) “ cannot be barren
 “ of praise to our CREATOR, nor unproductive to
 “ ourselves of that noble and uncommon union of
 “ science and admiration, which a contemplation
 “ of the works of infinite wisdom alone can afford
 “ to a rational mind; whilst referring to HIM
 “ whatever we find of right, or good, or fair in
 “ ourselves, discovering his strength in our weak-
 “ ness and imperfection, honouring them where
 “ we clearly discover them, and adoring their pro-
 “ fundity where we are lost in our search, we may
 “ be inquisitive without impertinence, and ele-
 “ vated without pride; we may be admitted (if I
 “ may dare to say so) into the counsels of the Al-
 “ mighty, by a consideration of HIS WORKS.”

* Essay on the Sublime and Beautiful.

II.

CUI BONO?

OR,

PHYSIOLOGICAL AND PATHOLOGICAL
OBSERVATIONS

ON THE FUNCTIONS OF THE
VISCERAL NERVES.

WITH SOME

R E M A R K S

ON THE ACTION OF

O P I U M,

AND OTHER

VEGETABLE POISONS.

BY JOHN

ON THE
OBSERVATIONS

ON THE NERVOUS

WITH

BY A. R. S.

ON THE ACTION OF

OF

AND OTHER

VEGETABLE TOBACCO

INTRODUCTION.

A LONG series of years is often required for the admission of new truths. The period cannot be limited to thirty or forty years.

It depends on circumstances peculiar to the age, the subject, and the author's situation; and mine certainly has no peculiar advantages.

'Twas thought audacity in *M. Fagon*, to defend the *Harveian* discovery, near forty years after the first promulgation of it in England.

Before truth in its silent, or disputed march, has roused the attention of the indolent, converted the supercilious, subdued the interested and obstinate, and reached the ears of all, an age has passed away.

It is thirty years since my early thoughts on the uses of the Ganglions of the nerves, were communicated to my correspondents Dr. *Whytt*, and Baron *Haller*, and in the Phil. Transactions in 1764, and seq. and more than twenty years since, on maturer reflection, my Essay on that subject* was published as a separate work.

My opinion has been silently attacked, and as silently adopted, without any explicit acknowledgement of the author, or, any direct quotation from his work. Several of the objections, which I have answered, were communicated in a correspondence with which I was honoured by Baron *Haller*, afterwards published in the supplement of the Encyclopedia: and I have reason to think, from a letter afterwards received, my answers were satisfactory.

My work was favourably received by Dr. *McKittrick*;† and not only received candidly, but ingeniously

* Salop, 1771.

† See Commentaries on the Principles and Practice of Physic, large octavo.

niously analyzed, by the celebrated Dr. *Tissot*, in his excellent *Traite des Maladies Nerveuses* *

Frederic Casimir, seems to have adopted my whole system, in a work published at Manheim, 1774, of which *Haller* gives an account in his history of Anatomy, 2 Tom. 666. † My Essay moreover has been elegantly translated into the German language, by Dr. *Kolpin*, a learned physician at Stettin. ‡

I say nothing of the private, and perhaps partial, testimonies of my correspondents.

Whether my ideas have been the occasion of the attention which, since the first publication of them, has been given by anatomists to the great sympathetic nerves, and the ganglions, I shall not determine,

H 3

mine,

* *Traite des Nerfs & de leurs Maladies*, T. 1.—p. 2.—page 120.

† Von der leben craft. "Voluntatem nihil in organa Vitalia posse, quæ suo officio defungi sit neceffe, cum tamen ganglia vim a voluntate submissam frangant. vid. *Haller*. Hist. Anat. 2 vol. p. 666.—See also p. 596. ib. for his account of my Essay on the Ganglions.

‡ Versuch uber den Nussen der Nervenknotten von *James Johnson*, &c. Stettin, 1787. 8vo.

mine. But, having attended to the learned and splendid works of *Neubaver*,* *H. A. Wrisberg*, of Gottingen,† *Dr. Alexander Monro*, at this time professor of anatomy in Edinburgh,‡ and *Walther*, of Berlin,|| I find nothing in them which does not confirm, the uses I have ascribed to the ganglions of the nerves. However much they differ from former anatomists, however much they have improved the anatomy of the great sympathetic nerves, they add to, and confirm the evidence, before known, that the cardiac nerves, and splanchnic nerves, proceed uniformly and constantly, from under ganglions, of the great sympathetic nerves.

I proceed to suggest some pathological illustrations

* *Johannis Ernesti Neubaver*, M. D. prof. Jenensis Descriptio nervorum cardiacorum, & de nervo intercostali dextri lateris cum Iconibus. 4to.—1772.

† *Henrici Augusti Wrisberg*, prof. anatom. Gotting. In Comment, Gottingen. 7 Tom. De quinta Pari nervor.—Et postea de nervo sympathetico Maximo, ibid. 1780.

‡ *Observations on the Structure and Functions of the Nervous System*, by *Alexander Monro*, M. D. professor of anatomy, Edinburgh, fol. 1783.

|| *J. C. Walther*, *Tabulæ Nervorum Thoracis, et, Abdominis. folio maximo Berolin*, 1783.—Very elegant figures.—Other works may have been published abroad, which have not come to my hands or knowledge.

tions and consequences of this apparatus, so invariably appropriated to the organs of involuntary motion.

In the next age, consequences of these truths, will be unveiled, to an extent not now to be conceived, but of the greatest importance in the healing art: in the mean time, what is here proposed, will furnish some direction to a sagacious searcher into the seat and nature of internal diseases.

THE HISTORY OF THE
 REIGN OF HENRY THE SEVENTH

OF FRANCE
 BY
 JOHN HENRY
 OF THE
 UNIVERSITY OF
 OXFORD
 IN TWO VOLUMES
 VOL. II.

OBSERVATIONS, &c.

FIRST PART.

Internal organs insensible to a degree ; as well as involuntary—Influence of passions extends to them, and to the glands—Palsy, and diseases of the head and heart—Cases—and, of the iris.

1. **T**HAT the brain is the principal vital organ in animals, the center of sensation, and the source of the energy and motions, of which they are capable, has been long known.

2. That the energy of the brain, is diffused over animated bodies by the nerves, and is occasionally excited in sensation and voluntary motion, has also been known since the days of *Erasistratus*, that is, for two thousand years.

3. That nervous energy is necessary to the involuntary motions of animals, has also, with some exceptions, been generally acknowledged. Many ingenious attempts had been made, to explain *how* these involuntary motions proceed spontaneously in animals,

animals, without the excitement of volition : but none of them with success, till *Senac*, Baron *Haller*, and *Whytt* discovered, irritability to be universally the acting spring in them.

4. But to support that irritability, and these vital powers permanently, the energy of the brain and nerves being found necessary, it remained to be explained, by what check, by what mechanism, the powers of volition were prevented from occasional and *active interference* in the involuntary motions. The uses proved in my former Essay, to belong to the ganglions of the visceral nerves, have removed this *important* difficulty.

5. These proofs demonstrate that the ganglions of the nerves, are obstacles and limits to the powers of volition in the nervous system, universally : the checks by which its empire is bounded, and its caprices guarded against, by our all-wise Creator, who, ever watchful for our preservation, gives us powers which are useful and salutary, and takes from us those, which would have been pernicious in the animal frame and œconomy.

No nerve goes to the heart, or to any of the abdominal viscera, but through the medium of a succession of ganglions.*

Nerves

* See *Wrijberg de Nervo intercostali*.

Nerves distributed to the muscles subject to volition, and to sensory organs, do not pass through the medium of ganglions.

When the nerves going to voluntary muscles are tied or cut through, such muscles are no longer voluntary; — but involuntary motions may be excited in them, below the ligature and incision. — In like manner, the proper functions of the glands, and the vital and involuntary organs, may be finally destroyed, by divisions and ligatures of the great sympathetic nerves, the only ones which are accessible, and on which anatomists can make such experiments.

I farther add, that stimuli acting above ganglions, neither act upon, nor occasion any contraction of, and in the heart and intestines; but acting below the ganglions, upon these organs, they constantly have that effect. The induction is complete and demonstrative.

6. Here let me not omit to observe, that the most accurate and diligent anatomists, find an evident and constant difference in the structure of the plexus, and ganglions. — In the plexus, the nervous filaments and medullary substance, may be traced, *unmixed*, to and from the nerves which contribute to the plexus, and which are associated
and

and united in them. Thus *Wrisberg*: “*Nervorum anastomosi, quasi vasorum instar, in unum filum confluerant, quæ non-nullis placet, vix assentiri possum: cum in plerisque nervis ramorum divisio, percissa intermedia cellulosa, ad ortum nervi continuari queat.*” De nervo sympathetico maximo. The same diligent anatomist has shewn, that in ganglions, the continuity of the nervous filaments is absolutely lost; or are therein so intangled and contorted, with cellular membrane and vessels, as to be hard like a callus. Yet the ultimate organic structure of a nerve is unknown, and so are its latent modifications, excepting those I have described, whether in plexus or ganglia: their characteristic marks and differences, are nevertheless obvious, their uses also are essentially different.—The associations in plexus seem destined to preserve *union* and *communication* betwixt the nerves in every part of the body, for the purposes of voluntary motion, and in a manner not very perfectly understood, to fortify the nerves for that purpose.

The ganglions, on the contrary, are organized for the purpose of separating from the power of volition, all the organs, moved by stimuli, acting on irritable parts, in the vital and other involuntary organs.—The heart,—the intestines,—the abdominal viscera, and glands in general,—the *Fallopian* tubes, and uterus—the iris.

Sensation,

Sensation, by the same means which intercept volition, is blunted in these organs, and irritability is increased.

The hardness and callosity of the ganglia is so great, and so widely different from the pulpy softness of the medullary substance of the nerves and brain, that in whatever mode imagination or theory, may account for the action of the nerves, that of ganglions, must appear totally different.—Let us suppose, that sensation and voluntary motion are carried on by a subtle fluid, moving with all necessary celerity in the nervous tubes; — the intricate convolutions of nervous matter, evident in ganglions, must necessarily retard, or intercept, or vary, the motion and direction of that fluid.—Call it vibration, or undulatory motion, propagated somehow or other along the nerves, still it would seem, that motion, must be impeded by these knots.

This doctrine, and the uses ascribed to ganglions resting on the same firm evidence, and *proof similar, and, as strong,* as that by which nerves are known to be instruments of sensation and voluntary motion, I proceed to shew their extensive influence in the animal system, in various particular instances.

7. I shall not here repeat the facts which prove,
that

that the glandular viscera are but very inconsiderably, and obtusely, sensible. This has been occasionally noticed by such as have related particular facts and observations, and was not unknown to the ancients. But it is fully proved by Baron *Haller* and his followers, in their innumerable experiments on various animals, to determine the irritability, sensibility, and insensibility of different parts in animals. The dull sensibility, or insensibility, observed by them and others, was not owing to a want of nerves in the glandular viscera, but to those nerves descending into them from ganglia, which prevent quick sensation, as well as voluntary excitement from the mind. But, like as the heart, though it cannot be affected by volition, is nevertheless liable to be agitated by passion, of greater or less force: so strong affections and emotions of the mind, influence the *secretions*: thus terror, and hypochondriac and hysteric fits, occasion a sudden secretion and flow of limpid urine: lust increases the secretion of semen; hunger, and a sight of victuals, cause saliva to flow into the mouth: tears are forced by grief from the lacrymal glands, and bile from the gall ducts, agitated by violent passion.

The mischief of violent passion on the nerves, and, system, is often unfortunately observed in nurses giving suck, and frequently occasions convulsions

vulsions in infants, and lays the foundations of abscesses and cancerous diseases, the consequences of inflammatory affections, and obstructions, in the breast, to be traced to this source. *M. Parmentier* (med. mem. Paris) observed, that milk drawn immediately after a nurse had recovered from an hysterical fit, to which she was subject, was *thin, colourless, and pellucid*; in an hour after, it was gelatinous, and after a few hours, and not sooner, it returned to its colour: the same alterations were renewed by succeeding paroxysms. This is analogous to the limpid urine of hypochondriacs; it affords an important caution to nurses, and well illustrates the œconomy of nature, in guarding by this peculiar apparatus of ganglions, our secretions from ordinary impressions of mind, which in a more excited state are so injurious: for in the ordinary and quiet state of mind and body, the mind has no influence over the glandular secretions, and can neither incite nor retard the velocity of liquors thrown into the glands.

8. To estimate the comparative degrees of nervous power and energy, necessary to the production and continuance of voluntary motion and sensation, we must have recourse to the phænomena of diseases, and chiefly of palsies, in order to calculate the difference, and make a comparison, which, so far as I recollect, has not been ascertained

tained by experiments. The number of patients, who, in palsies, lose the power of voluntary motion only, is vastly greater than that of those, who lose sensation along with voluntary motion: the instances in which sensation, together with voluntary motion, is completely lost, are very rare, and attended with a clear expectation of death, soon followed by an apoplexy, which verifies the prediction. Hence it appears that to voluntary action, a greater and more perfect nervous energy is required, than what is necessary or requisite, to convey mere sensory impressions.—For the most part, *sensation remains*, after paralytic seizures take away all power of voluntary motion, and is very rarely lost, but with the approaching extinction of life. I remember a few striking instances, in which the paralytic limb was so completely insensible, as to seem to the patient no part of his body; and to belong to some other person. Such was the first approach to apoplexy, which in a fortnight after, ended the life of my venerable father, in the eighty-seventh year of his age.

*Omnia debemur vobis; paulumque morati,
Serius aut citius, sedem properamus ad unam.*

Ov. MET.

9. I have, in my first Essay, shewn, that a continuation

tinuation of the vital and spontaneous motions in apoplexies, is owing to the nervous support, the heart and organs connected with it, derives from the ganglions and the nerves below them. This is equally applicable to a very frequent disease, the hydrocephalus internus; a disease as generally fatal as it is frequent. The son of an able surgeon, four years of age, after an illness of some weeks, in which the chief complaint appeared to be, languor and pain in the bowels, was at length seized with vomiting, followed with symptoms of pressure of the brain: after one convulsive fit, he lay completely insensible for three or four days. After death, three ounces of lymph were found in the ventricles of the brain. The pupil had been vastly dilated, and was immoveable by the approach of light. He possessed no sense of seeing, hearing, smell, taste, or feeling, for the last three days. I think indeed the senses in this disease are more completely extinguished, than in apoplexy: yet the motions and force of the heart, were very little diminished for some days. This case represents nearly others of the kind. The pulse, in the stage of vomiting and irritation, is irregularly quick: when stupor comes on, it is then slow and regular; respiration is rare, often interrupted with a sigh. Just before death the pulse becomes quick again, but with little force in the stroke.

In this disease the functions of the heart and intestines are supported, long after the powers of voluntary motion and sensation are completely extinguished: this support they derive from the ganglia. An attention to the course of the disease, much elucidates the dependance of the different functions of various parts, in different degrees of pressure, on the brain. When water begins to be collected, and *before its accumulation*, the beginning effusion acts as a stimulus, or irritation, on the brain and origin of the eighth pair of nerves, and produces pain in the stomach, nausea, and vomiting: when considerable accumulation has taken place, the pressure that results, extinguishes *voluntary motion and sensation*; and no powers continue to manifest or support life, except such as depend on the great sympathetic nerves and ganglions: viz. those of the vital organs and involuntary motions.

In the hydrocephali, which often takes place in the infant state, before the futures are closed, (and the brain confined by a complete ossification of the canium,) it is wonderful to observe, to what a degree and extent, the brain may be stretched, so as to resemble a membranous bag, of very large capacity: in this state life often lasts, for a very considerable time, with faculties much less impaired than could be supposed and expected.

Respecting

Respecting the vomiting which happens in attacks of this disease, in apoplexies, and in wounds, by which the brain is injured, it deserves to be recollected, that this symptom is also one of the consequences of incisions and ligatures of the eighth pair of nerves, along with those of the intercostal nerves, as stated in a note of my former Essay.

10. The greater irritability of the heart and of the intestinal canal, than of the fibres of muscles subject to voluntary motion, is particularly observed by such as are conversant in comparative anatomy. Nor have physiologists been able to account for the difference, by any thing observed in the muscular fibres in these parts: and no observation hitherto made, prevents us from concluding, that the muscular fibres, in the heart and intestines, except in retaining the property of irritability much longer, and more tenaciously, are perfectly similar to fibres in all other muscles.

This superior irritability in the heart, and other parts possessing it, is derived also, from the ganglions situated on the nerves, which are distributed to these parts.—By them, those occasional exertions of volition, and exercise, which require rest, and cessation in the voluntary muscles, are prevented from extending to the involuntary organs: by them, these organs, though so exquisitely irri-
I 2 table,

table, are rendered to a great degree insensible. Hence the energy of the brain, which is constantly proceeding to *instaurate* every part of the nervous system, and receives probably *augmented power* in the ganglions themselves, remains wholly appropriated to the use and support of the important and incessant motions going on, by the established order of the Creator, in the involuntary organs: and undergoing no diminution or exhaustion, by voluntary excitements, and by the waste, which takes place from the exercise of thought and sensation in the natural actions: the organs of involuntary motion, have no need of rest, like others, and while life remains they never sleep: hence that durable irritability in the fibres of the heart, and appearance of life in them, after the death of the rest of the body.

It is observable that the heart and other involuntary organs, are most irritable in young animals: a proof this property does not originate from habit, as has been supposed, and is not strengthened by it; but, is placed in the original fabric of animals, and supported in those parts by the ganglia of the nerves.*

11. The ganglions, by the same organization which

* Baron Haller on sensible and irritable parts of animals, p. 55.

which checks voluntary motion in the vital organs, render those organs very obtusely sensible.—Baron *Haller* has shewn that exquisite irritability in these parts and others, is perfectly compatible with dull sensation. This observation was much combated by his antagonists, and was not understood perfectly, in its true cause, by himself. “Irritability, says he, differs entirely from sensibility, and the most irritable parts are those which are not subject to the command of the soul.”*

Irritability depends on the connection of muscular fibres, with the matter of the nerves; but sensations depend upon impressions conveyed by sensory nerves, nerves destitute of ganglions, and rarely united in plexus, to the sensorium, or sentient being; the impediments to volition, are also impediments to vivid sensations: hence in the involuntary organs, in the heart especially, sensation is dull, but irritability very great. In the voluntary muscles, sensation and irritability are nearly equal. Had irritability, as supposed by Baron *Haller*, depended upon the animal gluten in muscular fibres, only, the fibres in muscles subject to the will, having as much of that, as the involuntary muscles, must have equalled them in irritability. I notice this only cursorily, and willingly acknowledge the obligations we owe to this great man:

man: my homage to his unremitting diligence, and ardent pursuit of knowledge.

12. Though volition, on account of the interposed ganglia, does not extend its power over the heart and intestines; and though the same means prevent these parts from giving us any sensible notice of the stimuli, which excite natural motions in them, and make us often equally insensible to weaker morbid stimuli; yet under much emotion and agitation of mind, the heart more especially suffers, as well as from uneasy feelings, less vehement in the moment, but of longer duration, such as fear, sorrow, grief, &c. long harboured in the mind.

These principles properly understood and applied, may, if I mistake not, give light to a great number of facts in pathology. In pursuing these researches, I hope and believe, I have not been led on by vain and useless curiosity; but by a conviction, that the light thrown on the uses and functions of the ganglions and visceral nerves, may guide us in the discovery of diseases, of great importance to be discriminated in their nature and seat, in order to be treated with success.

The examinations of dead bodies, in the immense collections of *Bonetus*, *Morgagni*, and *Licutaud*,

taud, furnishes ample evidence, how frequently, or rather how constantly, fatal diseases are formed in the vital organs, and in the abdominal viscera: how frequently these parts are consumed by collections of water and pus; tumours, adhesions, and inflammations are formed, of which attending practitioners had no suspicion. Even the great *Harvey* says he never opened a body, without learning something unknown to him. So inexhaustible is nature in instruction to attentive scholars. Often, indeed, we shall find, in consequence of our most accurate researches, that the patient who looks to us for health, labours under an incurable and fatal malady. That he has incurable scirrhoties, inaccessible abscesses, the pericardium distended by water, aneurisms in the thorax, the organs of circulation obstructed by mal-confirmation, as well as accidental diseases: what advantage do we derive from such painful discoveries, but the mortification of knowing the impossibility of finding adequate remedies, and, of giving the relief expected from us? Knowledge, nevertheless, will save the physician the mortification of attempting impossibilities, or aggravating misery by additional mischiefs: I shall therefore hazard a few more observations,

13. Besides the diseases by which the heart suffers from sympathy, a cause extremely exten-

five in its effects, and often occult in its *modus operandi*, it has a numerous train of maladies peculiar to itself: these have been examined with much diligence by *M. Senac*. But as science is progressive, and nature inexhaustible, those diseases seem capable of much illustration, from the principles I have endeavoured to explain; and which lead to truths he had no notion of, and throw light on the facts he has collected, with an industry and sollicitude, which might make some persons blush; who, to keep their ignorance in credit, attempt to deride that knowledge, which is the only guide to salutary practice, and which alone confers a right to the name of physician. The heart, ever unaffected by volition, is nevertheless, by its connection with the nerves and blood vessels, strongly and quickly agitated by the irregular and morbid movements of the body to which it is fixed, as well as by its proper and peculiar diseases. Irritations, which hardly affect the senses, agitate the heart. In fevers, the forces of the heart are sometimes excited, and sometimes weakened, but are always quickened and disordered. Yet the causes of fevers are for the most part, not only unperceived by the senses, but are seldom to be discovered by induction. In fine, the heart, which seems the *primum mobile*, dies, and has its motions extinguished, by the destruction of parts it seems to animate. The prick of a finger,

a finger, says *Senac*, the wound of a nerve, a locked jaw, an abscess, a beginning mortification in any internal part, and often in those that are external, lays the heart in fatal inaction, in such an unaccountable manner, that we frequently know as little why we die, as how we live!

14. The obscure and very dull sensation of the heart, makes us perfectly unconscious of its natural movements, though so frequent, so various, and so important to the support of life. Even its palpitations, are sensations of its impulse on the left side, and not of the heart. Hence it arises, that in the chronic diseases of the heart, the pains which result, are always distant and sympathetic. Thus in the disease lately known by the name of *angina pectoris*, it is characterised by pains across the breast, and at the insertion of the deltoid muscles in the arms, attended with anxiety, which deeply affects the patient's mind, and ends in sudden death. On opening the body, the heart has been often found affected in its valves, muscular substance, the state of the great vessels, or contents of its cavities. Likewise *cardialgia*, or pains in the epigastric region, with palpitations there, often arise from distension of the heart: and in general, the uneasy sensations which accompany or arise from the enlargement and dilatation of the heart and its vessels, arise from

from its pressure on the mediastinum, the lungs, the pleura, and diaphragm, and are not properly painful sensations immediately from the substance of the heart itself. This seems to have been observed by the ancients, and a few of the modern physicians. *Hippocrates* has several observations which evidently relate to the diseases of the heart. For instance: "Quibus—adfit etiam cordis, seu potius oris ventris dolor, hi ubi longius ægrotarunt peripneumonicorum modo moriuntur."—*Coac. Præn.* § 1.

"Oris ventriculi dolor seniore[m] frequenter Impetens, mortem repentinam significat." *Ibid.* See *Bannister's* case. On the whole it is certain, the most dangerous diseases may be formed within us, may sap the vital organs, and prepare our sudden extinction, without giving us any previous alarm.

15. Inflammations in the heart occur frequently: they may be discovered by an attentive, sagacious practitioner, but in general they pass unknown and unobserved, in dangerous peripneumonies and other inflammatory diseases of the thorax. The want of pointed pain, occasions the state of the heart not to be thought of: *Boerhaave* has well observed, that anxiety is the sensation peculiar to carditis: 'twas also the principal symptom

tom in the following melancholy case; in which a diseased state of the heart, which had followed a fall from a horse some years before, seems to have disposed the noble patient, to the inflammation and enlarged liver, which proved fatal to him, notwithstanding the able exertions of his physicians.

E. W. was for some years subject to palpitations, which he imputed to an injury he received on his left side, by a fall from his horse, during the American war.

In September, 1789, he began to complain of severe pain in the right hypochondrium, which encreased, notwithstanding bleeding and other remedies, and was accompanied with frequent paroxysms of extreme anxiety, during the progress of the disease, which continued till about the middle of October, when it terminated in death.

He frequently cried out in the agony of anxiety; but said the uneasiness which affected him was not what is usually called pain, but intolerable anxiety and inquietude. His pulse, during the greatest part of the illness, was feverish, very quick and strong, till within a few days of his death, when it intermitted. He died highly delirious in the thirty-eighth year of his age. On examining his body in the presence of his physicians,

The

The *membrana adiposa* was found tinged of a deep yellow colour.

The liver, at its anterior and superior part, was indurated, to an extent of not less than five inches in diameter, and protuberated forwards; other parts of it had some induration, and its whole substance had strong marks of congestion.

There were also some adhesions from the liver to the diaphragm, as also to the peritonæum and intestines.

The pancreas was indurated. There was not any thing unusual in the other abdominal viscera.

In the chest, the heart was found considerably larger than usual, closely embraced by, and strongly adhering to, its pericardium.

The lungs did not appear diseased; but the left lobe was compressed into a smaller space than in its natural state, from the increased size of the heart.

The adhesion of the pericardium to the heart, its enlargement, and the compression of the left lobe of the lungs thereby, must greatly impede the motion of the blood, through the pulmonary blood vessels; and also make its return from the liver difficult,

difficult, and thus contribute to its accumulation in that viscus: and thence arose those ominous feelings of agonizing anxiety and inquietude, without pain, which the patient complained of many days preceding his death.

Vestiges of inflammation are frequently found in the heart in dissections: sometimes the pericardium is thickened, and water or pus contained in it; sometimes purulent erosions are found in the substance of the heart, or it is invested with the buff, or inflammatory crust. In a subject examined by my diligent and ingenious friend, Dr. *Cheston*, the consequences of inflammation were very numerous. The pericardium contained three pints of a bloody fluid: the internal surface of this bag, was much thickened, and beset with fleshy granulations; in other parts its appearance was reticular, like the honeycomb of the intestines.

The external surface of the heart, in every respect, resembled the appearance of the pericardium. The lungs adhered almost universally to the pleura.

I was consulted December 28, 1787, for *M. C.* a maiden lady, in the fortieth year of her age: she had taken an emetic, which left much irritation. For two months she had suffered by palpitations

tations of the heart, *felt under the sternum*, as well as in the left side: pain under the xiphoid cartilage: cough without expectoration, short breath, pulse very irregular, and hardly to be felt in either wrist: she derives a temporary cessation from pain from camphore julep, with a little æther and syr. de mecon, and pills of assafœtida and extr. cicutæ.

January 2, 1788, the left jugular vein was observed to beat like an artery: which I have ever observed to be a symptom of encreasing danger, from collections of serum in the thorax: she died 11th; and her body was opened January 19, by Mr. *Russel*.—A quart of water was taken from the left side of the breast, and, the lobe of the lungs, on that side, was compressed to one fourth of its usual size: the lungs of the right side were large and sound. The dorsal vertebræ gibbose.

The heart adhered firmly to the *pericardium*, and *this* to the *pleura*, *mediastinum*, and *diaphragm*: Its apex, or point, being attached to the diaphragm under the xiphoid cartilage, (where pain had been chiefly felt,) and directly downward and backward.

The stomach was large and flaccid; the liver enlarged, but sound; soft biliary concretions were found in great numbers in the gall-bladder, though she had never laboured under jaundice.

The

The pressure of so great a quantity of water, added to the morbid adhesions of the heart to the pericardium, and of that, to the sternum and diaphragm, had impeded the motions of the heart, and occasioned them to be felt under the sternum and pit of the stomach. This situation preventing the right ventricle from exerting its natural contractile power, to propel the blood with proper force into the pulmonary artery, it passed from thence into the left ventricle, and, into the aorta and arteries, with a feeble undulatory motion, so that regular pulsations were hardly felt at the wrist.

The blood being resisted, by the pressure of the collected fluid, in passing through the lungs, the right ventricle of the heart became distended, and resisted the entrance of the blood from the vena cava; and, the re-action from this resistance, occasioned a pulsatory, or undulatory motion, resembling pulsation, in the jugular veins. It is said none of these symptoms appeared till after the emetic was given, which was followed by great encrease of irritation, and such symptoms of inflammation, as occasioned the patient's being bled.

William Bannister, æt. seventy, admitted April 9, 1792, in-patient in the Infirmary, for a sore leg: complained of pain at his stomach, with
strait

strait, and difficult respiration. On the third of May he died suddenly—body opened—the breast, abdomen, stomach, and viscera in the abdomen, found: omentum emaciated.

Thorax. The pericardium adhered in an uncommon extent, to the muscular and anterior part of the diaphragm, as well as to its tendinous part.

The right lobe of the lungs entirely adhered to the pleura, and mediastinum; a preceeding inflammation had caused all the adhesions.

The left auricle of the heart was extended to an uncommon degree; and when emptied of blood was larger than usual. The diameter of the aorta enlarged, its valves entire; ossifications were beginning, where the valves join the artery.

The pain felt from the adhesion of the pericardium, was naturally referred to the stomach, and was accompanied with sense of tight confinement, and difficulty in breathing. His pain was relieved, but not removed, by small doses of tinct. aloes and tinct. amara. The ulcer in his leg, was not healed at the time of his death. Hence it seems, issues do not certainly prevent sudden death in the angina pectoris, as has been suggested. But,
on

on the other hand, I have often observed asthmatic seizures follow the closing of old ulcers in the legs.

No water was found in the pericardium. The heart was larger in size, and its substance of a pale livid colour, and less firm than usual.

The adhesions must have rendered respiration laborious, and prepared other hidden causes of sudden death: we are not always to expect to see the causes of such alarming events; as they are often invisible and latent: they may arise from sudden spasm, from sympathy, as in the action of laurel water, or a sudden blow on the pit of the stomach, which is frequently fatal, or from a defect of irritability in the muscular fibres, or some unknown alteration in the brain, nerves, or ganglions: so various are the strokes which precipitate us to the grave.

In all these cases, and others similar to them, the pain in no stage of the disease, is at all equal to the extent of the mischief, which appears in dissections.

16. Inflammatory diseases of the heart have been found frequent and general, at certain seasons, and in particular circumstances.

Dr. *Huxham* (Ph. Transf. abridged, vol. ix. p. 135) gives an account of the prevalence of such a disease, in a number of seamen, returning from a warm West-India climate, into the English channel, in February and March, 1742, during exceeding cold dry weather. They were seized with short, importunate, asthmatic coughs, without expectoration: violent, and almost perpetual palpitations of the heart, with a constant intermitting trembling, fluttering pulse; and a constant anxiety, pain and sinking of the heart, as they expressed it. Excessive difficulty in breathing, and pains of the side in some patients, though with very little fever.

Twenty persons labouring under such symptoms died, notwithstanding the skilful exertions of this eminent physician.

The bodies of two patients were opened. Large and uncommonly tough white polypi, were found interwoven in the *carneæ columnæ* of the ventricles of the heart. The branches of these polypi shot a great way into the aorta, and its branches: one of the femilunar valves was, moreover, beginning to ossify.

These cases were clearly inflammatory dispositions of the heart: and it appears that the same causes

causes which generate pleuro-pneumies, may render carditis a frequent illness.

17. The eleventh article of the first vol. of Memoirs of Med. Society of London, gives an accurate history of the case of *John Judd*, aged twelve years. After a fall, a year back, he complained of pain and unusual oppression about the stomach and breast, which were much encreased by eating solid food.—The left side of the thorax was much enlarged, and there a strong pulsation was observed, extending with an undulating motion to the pit of the stomach, which was distinctly seen, even when covered by his waistcoat: this continued till his death, and he said, it felt, *as if his heart was rolling about like a great ball*. His pulse was low and weak, but neither quick nor irregular.

Another fall hastened his death. Water tinged with blood was found in the thorax. The lungs adhered in some places to the ribs and diaphragm. On removing the pericardium and heart out of the body, marks of inflammation were found on the surface of the heart: to which the pericardium adhered so strongly, that no force could separate them. The heart was enlarged to three times its natural bulk, and appeared like an unformed mass of flesh. The cavities of the heart were not larger

than usual, and its enlargement consisted entirely in the thickening of its muscular substance. See a case in some respects similar, in art. 23, of vol. 2, of Medical Essays of Edinburgh.

18. The following case, perhaps, began with inflammation, though its termination and nature were very different.

John Townley, æt. sixteen, became my patient in our Infirmary, January 6, 1793: he complained of great difficulty in breathing, and had spit blood by coughing, for some months past. His countenance was *uncommonly livid*.

I ordered him to take the following pills in the morning and evening, and the draught four times in the day; and he had some relief from them, especially in moderately opening the body. R. Pil. scill. scrup. iv. extr. cicut. scrup. ii. f. pil. xxx. R. Nitri puri, scrup. i. mannæ drach. i. aq. hordei unc. i fs. f. haustus.

He died January 18. — The symptoms immediately preceding his death, and the appearances in dissection, are thus related, by my son, Dr. *John Johnstone*, from his own observation and inspection.

An hour before his death, his face and hands became of a darker purple colour; he could not sit up, and sat leaning with his elbows on his knees. His breathing was extremely laborious, but he complained of no pain. No pulse was now felt at the wrist: though the pulsations of the heart were strongly felt in the side.—On dissection, the liver was observed of a deeper purple colour than common. The intestines were loaded with fæces, and part of the ilium was slightly inflamed; there was also an intussusception of the extent of an inch. The left side of the great arch of the colon was extremely contracted, so as to be much narrower than the small intestines: and half a pint of serum was found in the abdomen.

On opening the chest. The lungs were *white*, and full of tubercles: more than half a pint of a serous fluid was found in the pericardium: the substance of the heart tender, but of the natural size: the left auricle and ventricle, were extremely distended with blood, half coagulated: all the auricles and ventricles were full of such coagula, and white polypi.

Two of the semilunar valves were cartilaginous, and so much indurated, as to make it probable they did not completely close, and, that the projected blood, might again fall back from the aorta

into the ventricle. Moreover, the white appearance of the lungs, the colour of the blood, and livid appearance of the patient, make it probable, the blood had not been sufficiently oxygenated in its passage to the left ventricle of the heart. Hence a defective irritability, and its power, was insufficient to propel the blood in the arterial system: from its recoil and remora, the distension of the left ventricle ensued, and polypi were generated, and death terminated this incurable disease.

Mr. *Senac* has a very singular observation, viz. That abscesses in every part of the body produce syncope, except abscesses in the brain: if this is generally true, it shews that the dependance of the heart on the ganglions, is not only direct and immediate, but greater than its dependance on the brain.

I have dwelt the longer on observations of this kind, because, though it is generally known that the heart is acted upon by the passions, and by the irregular and morbid movements of every part of the body to which it is fixed, as well as by its proper diseases, yet it has not, so far as I know, been sufficiently *noticed*, that the proper diseases of the heart, are to be discovered chiefly by their *action* and *effects*, upon distant parts, by the connection and communication, of the nerves distributed

to them: and the greatest attention and sagacity will be necessary to discover its latent maladies; latent from its dull sensation, especially in their early attacks; yet such sagacity, aided by experience, will often be successful in the research, however difficult.

19. The *iris*, is another part, the sensibility of which is much inferior to its irritability: the law by which its involuntary movements, depend on the impulse of light on the retina, has been stated in my first Essay; but there are deviations from this, depending on peculiarities and morbid circumstances, as appears in the observations of *M. Wenzel*, the younger, on the operation of the cataract.

The motions of the pupil, regulated by, and usually proportioned to the degree of light striking upon the retina of a sound eye, are produced by the action of the ciliary nerves distributed to the iris, and these spring from the lenticular ganglion.

Among the symptoms, that promise success to the operation of the cataract, a free motion of the pupil, and that degree of mobility, which manifests itself by its quick contraction, upon a sudden exposure to light, is very desirable.

But this experienced oculist, has known some pupils retain the power of contracting and dilating, though the optic nerve be totally paralytic: though it much oftner happens, when the optic nerve is paralytic, that the pupil is nearly, if not entirely deprived of the power of motion: this state of the optic nerve is known by the total inability of the eye to perceive the difference between day and night.

There are also persons whose sight is good, and yet the pupils of their eyes, upon the most attentive examination, in different degrees of light, discover no motion whatever.

The cases related by this author, show that the cataract, had been extracted from several eyes so circumstanced, and, with the most perfect success: and, he has frequently remarked, that after the operation has been most successfully performed, and the light has been restored as completely as possible, the pupils have, notwithstanding, often remained almost without motion. § 9. p. 52.—seq.

It appears from cases, 6—18—27—28,—and others, that the immobility of the pupil, often proceeds from the pressure, and other consequences, of the diseased chrystaline humour, and, of the diseased state of the capsula of the chrystaline humour

mour adhering to, and, pressing upon, the nerves of the iris: the effects of which may remain after the diseased capsula and cristalline are removed.

But, the natural state of the iris, is to be insensible, and highly irritable, by light striking on the retina, and involuntary in its motions. *M. De Haller* observed, that the cornea is pierced through without pain: and it is known to operators on the eyes, and has been remarked by persons whose eyes are operated upon, that very little pain is felt in the operation of couching, or, extracting the cristalline. I have seen a patient, at the time the needle was in the eye, and while the operation of depressing the cristalline was going on, ask whether the needle was in the eye or not.

SECOND PART.

We are unconscious of internal stimuli—Sympathy—

Poisons—Opium—Its power, use, and abuse, &c.

1. **T**HE intimate connection of every part of the body, with the whole, could not escape the observation of physicians and philosophers.

It was acknowledged by *Hippocrates*, and has not passed unobserved, in the common sense of the people.

2. Some theorists, have affirmed it as a principle in physiology, that each individual nervous fibrile, extends, distinct and unconnected, from the brain to the muscle, or sensory point, in which it terminates.

This is far from being proved. The medullary matter in the brain, and in its terminations, when
divested

divested from the membranes, with which single nerves are covered, in their course to their terminations, have no fibrous appearance: and, besides the more complicated unions of the nerves in ganglia, unions less intricate, are perpetual in the spinal marrow, and in the plexus of nerves distributed to the limbs.

3. This communion of nervous substance in its course, as well as in the brain, seems the chief cause of that universal sympathy, which subsists in the animal body, betwixt each part and the brain, and betwixt one part and another, in certain circumstances. Some of these I shall notice; but, it is not improper, before we enter upon such particulars, and, indeed, as an introduction to them, to take notice of that obscure sensation, and unconsciousness of stimuli, and of irritations, both natural and morbid, observable in the organs which derive nerves from the ganglions of the splanchnic nerves.

4. This unconsciousness, has not been observed, or at least applied, to any purpose, in physiology or pathology: and, a supposition that all internal parts, were acutely sensible, was objected to the uses, I ascribed, to the ganglions of the nerves: the objection, gave me occasion to call out to observation, the important truth, that the internal organs,

gans, are destitute of distinct pointed sensibility. The very ingenious professor *Whytt*, in the chapter on the sympathy of the nerves, in his work on the nature, cause, and cure of hypochondriac and hysterical diseases, has objected to ganglia having any concern in sympathy, what follows :

“ If there were any anastomosis, or real communication between the nerves of the same or different trunks, either in the ganglia or elsewhere, it is natural to think, that a confusion would necessarily happen in our sensations, as well as in the motions of our several muscles ; for the impressions of external objects, would be *communicated at the places of union*, to other nerves than those affected : and the change produced by the will in any nerve, at its origin in the brain or spinal marrow, in order for moving a particular muscle, would affect all those nerves, with which it has any communication, by means of the ganglia or otherwise.” p. 40.

This needs no other answer than what was given by me long ago,—that ganglia intercept volition, and also render sensations obscure and indeterminate, in the splanchnic organs: facts these in the animal œconomy, which make it probable, that there is actually that intercourse and communication of various different nerves in ganglia, observed

served by anatomists; and speculations, however ingenious, must yield to facts.

5. The heart, the intestines, and most of the abdominal viscera, being insulated, by means of the splanchnic nerves, from the voluntary and sensory powers of the mind, we are thereby rendered unconscious of the irritations, which act upon the heart, and perpetuate its motions. The nerves of the stomach and bowels, both in health and in sickness, in the natural action of digestion and chylification, are stimulated; and yet these stimuli excite no perceptions in our minds, similar to the impressions produced by stimuli in the sensory organs, or other sensible parts.

The secretions in the liver, pancreas, kidneys, and other glands, go on in a natural state, without any perception, of which we are conscious: and dangerous diseases, are formed in those parts, though we are insensible of the ruin, that is undermining health, till the functions of the stomach, or of some of the viscera, are so far perverted, as to be at length felt, by considerable pain, or other sufferings arising from thence: for irritation in those parts, does not produce pain, till it be very great.

6. We take into the stomach food, and a great variety

variety of refreshments: the sense of hunger is removed by them, and we feel ourselves suddenly invigorated, without any other peculiar sensation of the alimentary substances, which produce this refreshment, and which, by their action upon the nerves of the stomach, have the most extensive influence.

If medicines are taken, we have no conscious feeling of their presence in the stomach, if not given in doses which create nausea, or which, in some other respects, disturb the system. Their action is only known, by their good or bad effects, and not from any immediate impression, of *distinct* sensation.

However sensible every one is of the distinct tastes, of different kinds of food and liquors, of the tastes of vinegar, pepper, salt, sugar, fruits, and wines, of different kinds, in the mouth, we feel that difference no longer, after these matters reach the stomach: they produce no other sensation, on the coats and nerves of that organ, than the removal of the uneasiness and languor attending hunger, with a sense of general invigoration and refreshment.

7. When the stomach is overloaded by substances it cannot digest, or, when irritated by excess, then
nausea

nausea and vomiting are excited, by these stimuli acting on its coats: and we are no otherwise sensible of the stimuli, producing these effects, but by the effects themselves, and, a depressing feebleness and uneasiness, antecedent to them.

This singular and curious fact, in the animal œconomy, of distant parts being strongly affected by stimuli applied to the stomach and bowels, where, for the most part, no particular sensation or commotion is perceived, is remarked by Dr. *Gardener*, in a work published at Edinburgh in 1784, as a remarkable circumstance in the constitution of their nerves.* “ For, says he, stimuli applied to other parts, whatever effects they may have in the system, are constantly felt first in the place where they are applied, which is not always the case with those acting on the stomach and bowels; on the contrary, their most evident effects are often in places remote from the viscera.”

Nevertheless, I have often seen patients, long martyrs to a morbid sensibility and irritability in nervous diseases, complaining of uneasy sensations, and internal emotions; which seemed to me to arise

* The ingenious writer was not ignorant of my opinion, published twenty years before, on the use and effects of the ganglions, that constitution of nerves producing those effects, so particularly noticed by him.

arise from the disturbed and accelerated peristaltic motions of the intestines, become thereby sensible and uneasy to the patient, in like manner as the motions of the heart, are in its palpitations; though we are usually insensible of the natural, and even of the less violent morbid movements of these parts.

8. The sympathy, observed in the human body, is universal, or, partial. It is likewise direct, or, indirect. It is also very properly distinguished, by the learned *Tiffot*, into active and passive. This subject is obviously of great extent and importance. The limited view I propose to myself, in selecting a few instances of this extensive range, will relate to some striking particulars of partial and direct sympathy, and afterwards, to some that are indirect and passive.

In direct sympathy, the impression is not interrupted, or circuitous, in its passage to the brain.—In cases of indirect and passive sympathy, the nerve primarily acted upon, often appears not at all affected, or, is less affected, than that which suffers by communication and sympathy.—In other cases, the sensation goes circuitously to the sensorium, and does not mark precisely, and determinately, the part originally affected.

In

In these cases the sympathetic sensation is generally the consequence of excessive irritation and stimulus, producing preternatural action, and pain, in parts on which we are unconscious of ordinary stimuli, and even of morbid stimuli of inferior force.*

Such sympathetic feelings, occur most frequently and permanently, in parts whose nerves proceed from ganglia; I consider, therefore, the phenomena as connected with them, as cause and effect.

9. The sympathetic action, or the distant sensation, arising from the original disease, often appears to be the principal affection, and perhaps the earliest notice, of internal disease. In the abdomen, that sympathy appears to me resolvable, into the vague, and, indeterminate, obscure sensations of parts, furnished with nerves solely from the ganglions, — It is produced, like direct sympathy, by excessive irritation: but in this indirect sympathy, the painful irritation is not principally felt in its primary seat, as it is always, in the cases of direct sympathy. Thus it happens, that the connection of the liver with the diaphragm, by the suspensory ligament, and, from the phrenic nerves arising from the third and fourth cervical nerves; and, the

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distribution

* On the subject of sympathy, the writings of Dr. Whytt, Dr. Gardiner, Dr. Monro, and Dr. Tissot, well deserve attention.

distribution of the remaining branches of the third cervical nerve, to the muscles and integuments at the top of the shoulder, and lower part of the neck : from this connection, it happens that an inflammation of the liver, occasions more pain in the shoulder, than is felt in the liver itself. Abscesses in the lungs, communicating with the diaphragm, or piercing through it, and all violent irritations of that muscle, which may happen in many other morbid affections of the abdominal viscera, occasion the same pain in the shoulder and neck, and are often accompanied with an ominous singultus.

10. The stomach sympathizes with every part of the body, more than any other organ.

Wounds of the head, and injuries of the brain, bring on perpetual vomiting, in the manner, that vomiting is excited by irritations, ligatures, or incisions of the eighth pair of nerves, in the experiments, which have been so often repeated by anatomists.

But the head is more frequently affected with pain, and a variety of other disorders, from a diseased state of the stomach, than the stomach is from the head.—Injuries of the head must be very great, to affect the stomach; whereas, wind, acid and bilious humours, lodged in the stomach and intestines,

tines, with a thousand other causes, not of the most serious nature, acting noxiously in the stomach, occasion dimness of sight, vertigo, pain in the head, hemicrania, and sometimes end, in producing epileptic fits, and alienations of mind. This has been occasioned also by worms in the intestinal canal.

Spasms in the stomach, extend to the diaphragm, lungs, and throat, and occasion returns of asthmatic fits, in persons subject to them, and a sense of suffocation in the throat: a tickling of the throat, on the other hand, causes nausea and vomiting.

A nausea in the stomach, whatever may be the cause of it, occasions depression, and some irregularity in the pulse. Hence in fevers, such irregularities, are often forerunners of bilious and critical discharges, by vomiting and purging.

Violent and long continued vomiting or purging, as in the cholera morbus, bring on cramps in the limbs.

When the stomach is loaded with indigestion, or distended by wind, languor, dejection, and debility, are felt over the whole body.

On the other hand, when languor and debility

are owing to the emptiness of the stomach, or to hunger, the immediate contact of grateful food, or of wine, upon the coats of the stomach, restores vigour to the body, and alacrity to the mind, before any of these ingesta, can have been received into the blood vessels, in the form of chyle.

11. It is chiefly by contact with the internal surface of the stomach, that medicines produce salutary effects, and poisons their baneful consequences: thus the stomach affords us numerous examples of the most general and universal sympathy, as well as of every species of sympathy. Yet in producing these universal or particular effects, the mind has no sensation of the presence of such stimuli in the stomach, and is totally unconscious of them, but by a grateful warmth, and, invigoration, if they are of a salutary kind; and of nausea, head-ache, dejection, or vomiting, if of a morbid kind.

In a word, it is by the sympathy subsisting betwixt the stomach and the whole body, that medicines act, and cure diseases by their primary, and often, their immediate operation on the nerves of the stomach. It is by the contact of opium with this organ, that pain is relieved, wherever its seat may be; and when over-dosed, life extinguished. — It is here, the cinchona, removes the morbid

morbid state, which causes intermittent fevers. The fever which affects the whole system, is cured by the contact of that invaluable remedy, upon the internal coat of the stomach only.

The salubrious powers of astringents, bitters, in short, of every species of medicine, primarily on the stomach, produce a consentaneous, salutary alteration in every part, however distant: on the state of that organ health depends; and diseases are removed by applications to it.

12. This powerful sympathy of the stomach, and its action on every part of the system, is very remarkable in the effects of poisons of every kind, received into the stomach.

Some poisons, indeed, act most powerfully in wounds; and, if swallowed, are rendered harmless by digestion, as the poison of the viper and rattle-snake: and some have extended that supposition, to the poison of rabid animals: But I believe this supposition has never been ascertained, by facts, and I certainly do not recommend the experiment, on the human subject.

Neither do I speak here, of the aerial, or mephitic poisons, which appear to destroy the vital principle by inhalation, and instant contact; and

extinguish life without a struggle, and sooner, than it is extinguished in the exhausted receiver. The effects of vegetable poisons in the stomach, are what I mean to instance in a few of them.

13. The American poison of the TICUNAS, which is so destructive, in the slightest wounds, to animals, though asserted to be innocent in the stomach, by some authors, has been found a deadly poison internally, as well as externally, in the experiments of *Fontana*.

But a larger quantity of it is required, to kill even small animals, in the stomach, than in wounds. Five grains of it, swallowed by a Guinea-pig and pigeons, caused death in twenty minutes: eight grains of it killed a small rabbit in an hour. *C. iii. p. iv.*

The fatal impression made in the stomach by the ticunas, is purely nervous: lethargy, convulsions, faintings, loss of strength, and loss of feeling, are the common symptoms produced by this deadly poison. — The mineral acids, are said to destroy its power.

14. The poison extracted by distilling the leaves of the LAURO-CERASUS, in which the distilled water

is

is strongly impregnated with the essential oil of the plant, is so quickly fatal, when swallowed, or when it touches the fauces of animals, that it does not seem to yield to the ticuna's poison, in the fatal power of extinguishing life. With less than two tea-spoonfuls of this water, taken internally, says *Fontana*, I have seen middle-sized rabbits fall into convulsions, in less than thirty seconds, and die in a minute. If given as an injection, to animals, it equally produces convulsions and death.—When given in a small quantity, convulsions, more or less violent, succeed, and the body gradually becomes lifeless, beginning with the hinder feet. If swallowed, in a large quantity, by animals, they die, almost instantly, without convulsions, and their bodies appear in a very relaxed state. It is fatal in wounds, as well as the ticuna's, but requires a larger quantity to kill in a wound, than when taken into the stomach, or given by injection. *Fontana*.——This ought to be considered by such as recommend this water, as an external application, to cancerous sores, and other malignant ulcers.

Dogs and horses killed by laurel-water, in the experiments of *Langrisb* and *Du-Hamel*, examined after death, had no appearance of inflammation. The stomach, and its action, appeared to them

injured and destroyed, solely by extinguishing the power of the nerves.*

Assisted by my son, Dr. John Johnstone, I tried the following experiments, with the distilled water of the leaves of the lauro-cerasus.

June 4th, two shell snails, and two snails deprived of shells, were put together, in a glass of strong distilled laurel-water. In a minute or two, they seemed lifeless and motionless: in ten minutes more they were taken out of the liquid, and were irrecoverably dead. On the 5th of June, two more snails; and on the 8th of June, four black snails, were put into the water distilled from lauro-cerasus: they all died in a short time, much sooner than in a strong solution of opium in water.

July 15, a small young frog, thrown into a glass of distilled water from lauro-cerasus, was dead

* Mr. Dolz, in *Essays on Vegetable Poisons*, published at Nuremberg, found himself seized with pain in the head, stupor, and diarrhoea, for a week, by chopping the leaves of lauro-cerasus. Thirty pounds of these leaves, collected in a room, killed twenty birds out of a hundred, in the same room. Two drops of the distilled water, killed several small birds. —The expressed oil, and water distilled from bitter almonds, was fatal in like manner to a goldfinch, chaffinch, pigeons, and rabbits. A cat became paralytic by eight drops. The water was deliterious in glysters, in wounds, and injected into the vagina of female animals: wounds became putrid by it. Distilled water from box-leaves, yew-leaves, and orange-leaves and hops, were innocent.

dead in half a minute: on taking it out immediately, I burnt its toes in a candle, but observed no appearance of pain or sensation. Of two large frogs, whose heads were dipt about a minute in the same glass of water of lauro-cerasus: the smallest was dead in ten minutes, the largest in fifteen minutes: on burning the toes of one of them, no sign, of sensibility or life, appeared.

Nevertheless, when they were opened, the heart of each of these frogs, continued their regular pulsations, for a considerable time; though they shewed no pain, or any other mark of life, when they were opened. This experiment should be reconsidered by *Fontana*: of my opinions, on the use of the ganglions, it is a new proof.

The quickness with which sensations are conducted by the nerves, seems not much greater, than that velocity, with which this poison acts, in destroying the vital power, in the whole nervous system, when applied to any part of it, particularly the stomach; so immediate is the communication, and so quick its fatal effects.

14. *CICUTA AQUATICA*. In the account *Wepfer* has given of the poisonous power of this plant, its terrible effects, on the nervous system, are displayed. Seven children eat this root, mistaking it for
a different

a different plant: the consequences were violent pain in the stomach, and a moment after, convulsions and insensibility; during which *Jacob Mader*, a child six years old, made water with such force, as to raise it five feet high: his eyes were horribly distorted, and the teeth and jaws so locked, that they could not be opened. He had a strong hic-cough, and frequent efforts to vomit, but threw up nothing. A swelling of the stomach was observed, his limbs were convulsed, his back bent backwards like a bow: he died in those convulsions in half an hour. Five of these children recovered, but for some time complained of great uneasiness in the stomach. *Boerhaave* saw eight children, who had eaten the same root, and were affected with delirium, and convulsions; by giving a solution of white vitriol, he recovered all, that were vomited by it.

The *CONIUM MACULATUM*, (*cicuta maculata*), though in a less degree, produces the same effects if over-dosed. The extract is much used, medicinally.

SOLANUM NIGRUM. *Lin. Spec. Pl.*

HORTENSE—*Dod. Blackwell, &c.* in a large dose, excites vomiting, vertigo, and causes impaired vision: and, in a still larger dose, acts as a sedative

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tive poison. *Linnaeus*, *Mat. Med.*, briefly gives its powers. *Vis anodyna, refrigerans, repellens. usus, Inflammatio, Proctalgia, Scirrhus, Paronychia.*

The late *Mr. Gataker*, about the year 1757, recommended it, as a corrector and sedative for painful impure ulcers. He tried it in small doses with some effect, but afterwards found it unfit for general use.

At this time, I made some experiments with it. I had formerly observed the very slow movements, of the heart of shell snails, in summer, when they are most lively, its pulsations hardly exceeding, fourteen in a minute.— In the winter, the motions of the heart are considerably slower, and are hardly perceptible in these creatures, till roused by warmth or stimuli; then perhaps seven contractions may be observed in a minute.

The heart of a snail is triangular, and like the whole animal pale, as the white of an egg. This organ, sufficiently discernible by its pulsations, is protected by the spiral shell, the proper covering of these insects: and it is situated under the strongest arch of its spinal covering, and, in a part of the body of the snail, which is never protruded out of the shell, and is moreover protected, by a strong muscular covering, which corrugates upon the least touch,

touch, after the shell is broken: such provision is made for the preservation and security of these reptiles.

Like most other cold animals, the shell snail moves briskly for many hours, after its heart is cut out: yet does not finally survive the loss and destruction of that organ, which sooner or later causes its death, as in other animals.

Having made strong infusions of the herb, *solanum lethale*, and *solanum hortense*, I put snails, with their shells unbroken, in each of these infusions, several times; removing first of all a membranous covering, which in winter guards the entrance of the shell, so that the infusion might reach them. Thus they lay twenty-four, or thirty-six hours, in which time they were constantly dead, or past recovery; the heart at rest, flaccid, and insensible to all stimulus. The animal besides, was either wholly retracted into its shell, and, in a rigid convulsed state, or if some part, viz. its head protruded out of the shell, it was flaccid, as if the animal had died paralytic: this, I afterwards found the appearance of snails killed by opium, and distilled water of *lauro-cerasus*, and other poisons.

If the snails are examined in seven or eight hours,

hours, after lying in these poisonous infusions of solana, even in that time, the heart is found motionless, the rest of the body as yet retaining some languid movement; but less lively than what it was capable of, seven or eight hours after the heart was cut out.

Snails with their shell, and without it, when put in like manner, and, for as long a time in common water, appear to suffer nothing, and come out as lively as when they were put into it. I threw snails, deprived of their shells, and the heart uncovered, into infusions of solanum hortense: the motions of the heart appeared at first quickened, but in less than eight minutes it became motionless. The snail only not quite dead, moved a little when the head, which seems its most sensible part, was touched.—Other snails, in whom the heart was laid bare in like manner, appeared in common water as lively, as they were out of it, as long as I observed them.—These observations evince the strong sedative powers of solanum, and shew that irritability in snails, is affected by poisons, as in other animals, which makes them convenient for such experiments.

16. ATROPA BELLADONNA, SOLANUM FURIOSUM, is a sedative poison in all its parts, its roots, leaves, and

and flowers. Vis. Phantastica, paralytica, narcotica, anodyna. *Linn. M. M.*

It acts particularly on the nerves of the eyes.

Juncker saw a patient rendered blind, by an infusion of the leaves, taken for a cancer. — *Ray* saw a woman lose the power of contracting the iris, even in the greatest light, by applying a leaf of this plant, to a small cancerous ulcer near the eye. In others, it only occasioned spots, and other unusual appearances before the eyes, with weakness of sight.

In children, or others, who have eaten plentifully of the berries, delirium, fury, convulsions, thirst, and immobility of the pupils of the eyes, exposed to light, have followed: and, though straining to vomit is a common symptom, the irritability and contractile powers of the stomach, are so far impaired, that large doses of emetic tartar, are often ineffectual, without other assistance, such as long continued irritation on the fauces by feathers. Those who cannot be made to vomit often die (See *Ray*, *Lightfoot*, *Plenck*, and others.) In four children, mentioned by *Plenck*, the recovery of sight was remarkably slow. P. 120.

NICOTIANA, TABACUM. L.

Acts,

Acts, as is well known, powerfully as an emetic and cathartic; and, in too large a dose, as a narcotic, or sedative poison. In a case which fell under my observation, a strong decoction of tobacco, given as a glyster, occasioned, in a few minutes, convulsions and death in a child, to which it was administered for worms.

HYOSCIAMUS NIGER.

————— *ALBUS.*

Qualitas. Virofa. Vis Inebrians, phantastica, Venenata, Anodyna, resolvens. L. M. M.

The last is not so deliterious as the former. — A strong decoction of it, very soon killed several snails, and two frogs. After the decoction had stood some days, its virulence was abated: and at that time, three frogs thrown into it at night, though much debilitated, were alive the next morning, and soon recovered their agility in the open air.

17. *DIGITALIS PURPUREA. L.*

Emetico-catharticum torminosum, singultum, convulsiones, erosionem oris, ventriculi & intestinorum atque mortem causat. Plenck.

This

This plant is one of the efficacious simples which was used in the last century, and the beginning of this; and was again laid aside: though professor *Alston* said concerning it, as well as the hyosciamus and some other plants, *Meliora vix India mittit*.

I began to use the digitalis for dropical patients in the year 1776; and soon after I was elected one of the physicians to our Infirmary, in 1783, I recommended it as a proper medicine for our dispensatory. It has come into general practice, as a powerful diuretic medicine, chiefly since Dr. *Withering's* useful account of its medical use, has been published. I have used it very frequently, and have often experienced its extraordinary efficacy in dropies: and in hands, who know how to use it with discretion, it is a valuable medicine, and as such, will probably keep its station in future practice.

I lately made a strong infusion of the recent leaves of digitalis; the smell of the warm infusion strongly resembled that of tobacco, (to which, by the way, its botanical character has no affinity,) and the brown colour it assumed, being also very like an infusion of tobacco, I was led to give some of the dried leaves to habitual tobacco smokers; who agreed in calling it, a fine flavoured tobacco.

An infusion of the dried powder, which I had kept in a close-stopped bottle, at least five years, had the same brown colour, and strong smell, like tobacco: so that its powers appear to suffer little or no diminution by keeping. I have given this medicine, in its usual forms, and even in glysters, with various effects, often such as gave me great satisfaction: and, I am now inclined to think, that in asthmas, and some other diseases of the breast, it might be smoked with advantage.

Two frogs put into the decoction in the evening, were found dead next morning: I found it also, though slowly, and in a considerable time, fatal to snails; though some of them seemed suffocated rather than poisoned, and others but little affected by it.

I have known the digitalis occasion not only depression, intolerable anxiety, and nausea, but also affect the optic nerves of weak patients in an alarming manner: for some, under its use, thought they saw various different colours on the walls before them. In many it has occasioned considerable itching on the skin. Many patients I have happily and suddenly cured or relieved in dropical complaints, sometimes with, and sometimes without, an increased secretion of urine, by means of this medicine: while others have felt no lasting benefit

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from it, but on the contrary, were injured, by the extreme debility and intolerable nausea, and still more by the sudden diminution of the powers and action of the heart, it occasioned.

Here too the sympathy of the cardiac nerves, arose from the powerful action of the digitalis, on the nerves of the stomach.

It appears from the observations of *Wepfer* and others, that when the force of poisons, is inferior to that of producing instant death, the convulsions, and other effects of re-action produced by them, are most remarkable in parts, at a distance from the seat of their immediate action. And, it is evident the kidneys, and urinary bladder, are constantly much affected by a derangement of nerves, whether that derangement be the consequence of poison, or singly of nervous diseases arising from other causes.

ACONITUM NAPELLUS. L.

Its root in powder, was given by *M. Sproegel* to a cat three months old: after much agitation, its hinder legs became paralytic, and it was seized with convulsions, and slept with its eye-lids very closely shut. — On the morrow it recovered; and was killed by a drachm, or double dose of the root it had taken before.

Being

Being opened, the stomach contained some of the poison mixed with food; but was neither inflamed, corroded, extended, or contracted: in a word, it appeared sound, as did the intestines, and other parts, excepting the urinary bladder, *which was so contracted, as to be almost without any cavity.* Tiffot, Des Nerfs. T. i.—p. 11. p. 58.

The juice of this plant applied to a small wound of the thumb, occasioned a large suppuration, and gangrene, great pains in the arm, also, heart-burn, anxiety, fainting, and sense of suffocation. *Plenck*, p. 168, Toxicolog.

It is recommended in very small doses, mixed with sugar, in rheumatism, scirrhus, scrophula, venereal ulcers, asthma, and epilepsy, by *Stork*.

19. PAPAVER HORTENSE SEMINE ALBO, and, more especially, its inspissated extract and juice, OPIUM.

The attention of physicians has deservedly been turned to opium: in order to ascertain its powers as a poison, and its operation on the animal œconomy, experiments have been tried, on animals of various kinds, by Dr. *Alston*, Baron *Haller*, Dr. *Whytt*, Dr. *Monro*, *Fontana*, and others.

By the administration of a solution of opium, injected into the stomach of a frog, while the membrane of its toes were under a good microscope, a surprising diminution of the blood's velocity, in the small arteries, was distinctly seen, by the worthy professor *Alston*. In half an hour after, the blood recovered its wonted celerity. By a second and larger dose, given an hour after the first, and, after the recovery of the frog, the blood was seen to move much slower than after the first dose, and, its velocity gradually decreasing, it stagnated at length; first in the smaller vessels, and in almost a quarter of an hour the animal expired. One thing was very observable, — that notwithstanding the diminished velocity of the blood, there was no sensible diminution of the frequency of the pulse; yea, when there was no circulation, or progressive motion of the blood, the pulse was visible by an undulatory motion; that is, the blood returned as far back, at every diastole of the heart, as it was protruded by the preceding systole; this continued till the frog was dead. On opening it, nothing was found in the stomach, but a clear mucus, coloured with the opium, of which it was full. This experiment was often repeated, and always with the same appearances and event.*

Opium, injected either into the stomach or intestines

* Dr. *Alston's* Dissertation on Opium, art. 12. — 5 vol. Med. Essays.

testines of frogs, or even applied to the muscles of their belly, laid open, produces a paralytic weakness, and at last stupor and death; though the nature of these animals is such, that opium does not kill them, near so soon, as dogs are killed by it.*

A solution of opium injected into the great guts of a dog, in a few minutes brought on a palsy of his posterior extremities, attended with convulsions and stupor. Some days after, the like solution, was injected by a perforation through the integuments, into the abdomen of the same dog: he became paralytic instantaneously, and died in a few minutes. *Ib.* 20. I observed in general, says *Fontana*, that opium given to animals with warm blood, in moderate doses, increases the force and motions of the heart: the increase of resistance in the capillary vessels, by the torpor induced there, well accounts for this: but, he goes on, if it is given in a great dose, it seems at once to diminish the vigour of the animal, and the force of the heart.

He made twenty-four frogs swallow opium, and instantly took the heart from twelve of them, and opened the thorax in twelve others, without taking out the heart.—He found that the effects of the opium, sooner appeared, in the frogs whose hearts remained in the thorax, than in those deprived of

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* *Whytt on the Nerves; and Edinb. Essays, Physical and Literary.*

it. The difference in time was more than one-half. The effects of opium, consequently, are quicker in animals retaining the heart, than in others deprived of that important organ. *Fontana*, 2 vol. on poisons, p. 390 and seq.

A drachm of opium given by *M. Sproegel* to a dog of middle size, made the animal tremble, and froth at the mouth, as soon as it was swallowed; he continued in this state, weak and heavy, from nine o'clock in the morning, to four o'clock in the afternoon of the next day. — He was then opened: the peristaltic motion of the stomach and intestines, was almost at an end; the urinary and gall-bladders were full, sensibility very much diminished, the bladder irritated with spir. nitri, contracted but little.

The same dose of opium given to a lively cat, made it delirious, and lose the power and use of its hinder legs. On opening the body, yet alive, the peristaltic motions were not so much diminished as in the dog, and the urinary bladder retained its irritability: this cat was opened six hours after the dose was given; hence the peristaltic motion of the intestines, was not so completely subdued as it was in the dog. In two more dogs, the same appearances were observed: moreover, they lost immediately and entirely, the mobility of

of the iris, so that the approach of a bright candle, or perfect darkness, produced no change in it. See *Tiffot des Nerfs*. T. i. p. 11. p. 63.

21. So long ago as 1756, I made the following experiments, as well as several others, which I have formerly noticed.

Having opened the abdomen and breast of a kitten, only two days old, I cut out the heart, which continued its systole and diastole in a very lively and regular manner, and, in that state, put it into a tea-cup containing some laudanum: in that moment the pulsations of the heart ceased, and could not be renewed again with warm water, or any kind of stimulus. The same event happened to a piece of the intestine, cut out, when dipped in laudanum: the peristaltic motions, which were brisk before, ceased instantly, and could not be renewed by stimuli. I repeated these experiments in another kitten, three weeks older. Having divided the heart in two pieces, out of the body, one of them was thrown into laudanum, a little diluted with water, which in a very little time lost its pulsatory motions, and stimuli had no power or effect in restoring them: but the other half of the heart, lying at the same time upon the table, contracted very briskly whenever it was touched with the point of a needle, or a knife,

and that long after the other half, steeped in diluted laudanum, remained immoveable. Laudanum put a speedy end to the peristaltic motions of a piece of intestine, taken from this kitten, as from the former one: yet another piece of the small gut, cut out, lying on the table, continued to move and twist itself with great vivacity, when it was stimulated. So strong is the principle of irritability, and of life, in such young animals; and so certain is the power of opium, in putting a sudden end to it. I very lately dropped several snails into a mixture of laudanum and water: far from restlessness, or other sign of stimulus from the action of the mixture, the reverse appeared: they never stirred, lay motionless, and slept, in a few hours, the sleep of death.

Mr. Y—, of the age of fifty years, took by mistake at bed-time, about ten drachms of laudanum: he had a fit of gout at the time. No alarm was given till about four or five o'clock next morning, when excessive drowsiness and languor came on: after that he took repeated doses of tart. emet. by which some of the laudanum was rejected by vomiting.

I saw him about nine the same morning: his paleness, languor, and lethargic disposition, were very great; his pulse beat languidly, about thirty-eight

eight strokes in a minute. By stimulating his throat with a volatile embrocation, he was impowered to swallow, (for that function was much impaired,) a stimulating cathartic: blisters were applied to the back and arms; and sinapisms to his feet. He took, by my direction, coffee frequently, and after each dose of it, a desert spoonful of vinegar. He was also carried out, and well shaken in a post-chaise on a rough road. About four o'clock in the afternoon, he was so much roused, that his pulse beat at least seventy strokes in a minute: I now thought him safe. The dangerous sedative power of this enormous dose of opium was thus obviated, and his brain put into such a state of vigilance, that the ensuing evening, he spent a restless night. He enjoys since, and at this time, a tolerable state of health.

When I have taken opium for a tooth-ache, the diffused uneasiness is first removed by it, after that the pain in the tooth and gum cease, and rest supervenes, at least for some time: this is a specimen of the general way opium gives ease, in cases of less and greater importance.

23. These facts shew that the power of the nerves, throughout the whole system, is destroyed, by the action of opium on the nerves to which it is applied; and, that the most distant nerves, almost

most instantaneously, submit to its power, certainly long before it can be received into the blood vessels, or be conveyed by them to the remote parts of the system: and, in frogs, we see it suddenly takes away every appearance of life, after the heart is taken out. I do not say how it acts so extensively, or by what means it is conveyed; the fact is certain:—and, thus, the nerves in some manner, yet unknown, conduct the principle of life, with astonishing celerity, and afford almost as quick an entrance to the instruments of death.

But this is not the purpose of nature: on the contrary, it is by the same salutary law, that the refreshment of food, and healing powers of medicine, are diffused over our frame; and, that opium, under skilful direction, restores ease, and preserves life.

After having been so long used in medicine, it may seem surprising, that any controversy, any difference of opinion, concerning the operation of opium, should continue undecided: I do not speak of the more ancient opinions, *whether it is cold in the fourth degree*, according to Galen's followers; or, whether in opposition to them, it is not. I now consider, whether it is *absolutely a stimulant*, or *potentially a sedative medicine*; or, as some think, both a stimulant and a sedative medicine.

24. I believe it will not be denied, that large and poisonous doses of opium, are fatal by directly extinguishing those vital powers in the nervous system, by which they are the instruments of sensation, and, of every action in the animal œconomy.

The lesser doses of opium act, in proportion to the quantity, in a similar manner to the greater doses, on the nervous system; and while the former extinguish life, the latter assuage pain, and moderate excessive and unnatural spasmodic motions, both as palliatives and remedies: and, when judiciously applied, with very salutary consequences.

Small doses lull and benumb sensation, and suspend its exercise; and, abate both the power and exercise of motion: this suspense, contributes to the restoration of the nervous power, perhaps in the manner it is renewed in sleep: so that animal invigoration in this case, is not roused or exhausted by stimuli, but, by a remission of action; the proper benefit and effect of this sedative remedy, when applied with judgment.—Like the power ascribed to the rod of Mercury, in the *Æneid*.

hac animas ille evocat orco
 Pallentes, alias sub tristia Tartara mittit;
 Dat fornios adimitque, et lumina morte resignat.

Thus

Thus opium, may produce effects, very different and opposite, according to the dose, and the disease and constitution of the patient. When given seasonably, and with discernment, the ease it gives, is a prelude to the preservation of life, and the restoration of health: in rash, in unexperienced and unskilful hands, it is often a speedy passport to the grave.

25. From the facts and observations enumerated hitherto, from 19—24, it appears that opium acts as a potential *sedative*, and, *only as a sedative*.

The stimulating matter contained in a grain or two of opium, is very inconsiderable, compared to the stimulating power in pepper, and a hundred other simples, which have no such effects on animals as opium: so that the action of opium cannot be similar, or attributed to stimulus.

If at any time it appears to have different powers, they are *secondary* effects, such as are consequences merely of its primary proper sedative power, acting upon the living system in various conditions, of health and disease.

This medicine having formerly been applied, very perniciously, in fevers, and doctrines having been lately promulgated, which threaten a return
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of such abuses, I shall add a few reflections, the result of experience and observation, on the use and operation of opium.

Externally applied, except in wounds, its effects are seldom very conspicuous. In glysters, its operation is hardly less powerful, than in the stomach. When received into the stomach, its operation is powerful and extensive, in consequence of the sensibility and connection, the nerves of that organ have with the brain and heart, and every part of the body.

By rendering us less sensible to the stimulus of ordinary sensation, and of pain, the procuring sleep, is one of its earliest consequences: that is, a temporary suspension of the functions of sensation and voluntary motion, takes place. In the vital functions, the heart becomes less sensible to the stimulus of the blood: and its motions, and the pulsations of the arteries, with respiration, are rendered sensibly slower, and the pulses thereby fuller.

Its powers, of lessening the irritability and activity of the alimentary canal, and, of diminishing and suspending every evacuation, that of sweating alone excepted, are well ascertained. As it is certain, an increased dose ends in the extinction

unction of every animal function, it is evident, that the proper operation of opium, whether in small or greater doses, is uniformly sedative, and that by this power, health may be restored, and life extinguished.

The resistance given by the vital parts, to whatever tends to their extinction, occasions secondary effects, which have been mistaken for the direct consequences of the primary powers of opium. This has occasioned an error, of practical importance, by which a stimulating, and *direct* strengthening power, has been attributed to opium, as well as its proper sedative power. The struggles of the *vis conservatrix naturæ*, to resist powers, operating towards its extinction, and the convulsions of death itself, have been deemed evidences of a stimulating power in opium, and of vigour derived from it.

But we maintain, that, opium, in some degree, constantly weakens and relaxes every animal function; that it benumbs sense, and makes us less apt for muscular exertion; and, that it never bestows strength, but when, by its sedative power, it suspends or cures diseases, in which spasms, pains, protracted vigilance, and excessive evacuation, weaken the system. Opium in this manner strengthens, when it puts an end to a
nephritic

nephritic fit, cures a cholic, moderates and checks any excessive discharge of blood, cures diarrhœa, or gives rest in the torture of rheumatic and gouty pains.

That the convulsions, and other re-actions which appear in animals, arising from lesser doses of opium, and other sedative poisons, are not the effects of stimuli, appear from this: that large and increased doses of the same administered, instantly extinguish life, without struggle and resistance.

26. Dr. *Cullen* allows, (*Mat. Med.*) that narcotics generally weaken the powers of vital motion; yet inconsistently asserts that opium, in its first operation, often irritates the sanguiferous system, and excites the force of circulation. The only colour for this assertion, seems to be the conflict which takes place, between the natural and morbid stimuli acting on irritable organs, and the sedative power of doses of opium, insufficient to quiet these irritations altogether. The fact is this, the forces of the heart are weakened, and the circulation of the blood retarded, by the sedative power of opium, if the dose be sufficiently powerful. If small and inadequate, the effect may be imperceptible; but it would be absurd to alledge, such doses create powers, they are unable to suppress.

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It has been said the stimulant, as well as sedative power of opium, is manifested by some of its preparations, proving powerfully sudorific: not to mention the powerful stimuli added to opium in *Theriaca* and *Dover's* powder, and other compositions. Sweating is generally caused by relaxation of the surface of the body: in this operation, opium brings on a state, in some respects, analogous to the sweating, which in relaxed constitutions takes place during sleep, the effect of debility, and, as in hectic diseases, of colliquation.

In a word, the operation of small and salutary doses of opium, *is ever potentially sedative*, and exactly similar to that by which, in poisonous doses, it is known to destroy irritability, and extinguish life.

27. Dr. Cullen's ideas of the operation of this medicine, appear to me contrary to experience.

" We are disposed to think, says he, that all continued fevers arise from contagion, or from certain corruptions of human effluvia proving contagious; and it is highly probable that these contagions, or matters similar to them, act *as sedative powers*, and applied to the human body, produce debility, which both induces a fever, and subsists during the whole course of it. In this view of the matter,

matter, *opium as a stimulant*, to the heart and arteries, may be considered as a principal remedy in fevers; and *as such*, we are disposed, with the most part of our present practitioners, to consider it. But that it is *universally such*, and in every circumstance of fever proper, we are far from thinking."

In the general view of narcotics, the Doctor, had properly considered their powers as *universally debilitating and sedative*: how then can opium, one of the strongest sedatives, and, of the narcotics, be considered, in its primary operation, as a stimulant to the heart and arteries? This conclusion is one of the instances which shows how little the rules of induction have been attended to by physicians, in this instance at least.

Sydenham's method of giving opium in fevers, and some other diseases, deserves the particular attention of young practitioners.

In the decline of fevers, when the return of strength has been prevented by restlessness, and a watchful state of the brain, a gentle anodyne is often useful; not because it is a stimulant, but, on the contrary, because its sedative power removes inquietude, and induces sleep, that great restorer of animal powers. Hence, though it operates primarily, as a potential sedative in the sys-

tem, the sleep procured by it, in a secondary way, renders it a restorer of health.

In phrenitide, prout febris depuratoria symptomate, postquam venæ sectiones liberaliores, refrigerantia assumpta, et clystera; donec in diuturnitatem aliquam affectus excurrat, quo tempore non admodum difficile erit cum et a morbo et a symptomate, una eadem opera liberare: id quod fiet narcoticum aliquod medicamentum in largiori paulo dosi exhibendo.——— *Narcotica in principio, augmento, vel statu hujus febris, ad symptoma hoc levandum, vel non prodesse, vel sæpius obesse, tamen opportune et in declinatione morbi adhibita, præclaros effectus edunt, nec citius die morbi duodecimo prospere exhibitum novi.* Sydenham.

I make this remark the rather, as I find the giving of opium, almost in every state, the beginning, and increase not excepted, and, every kind of continual fever, has in some places become a fashionable routine, upon *Brunonian* principles. I have observed, where this fashion has prevailed, fevers are oftner fatal than they used to be, in the same circumstances and situations.

From the premature and injudicious administration of opium, necessary and salutary evacuation by stool is prevented: bilious and putrid fæces, with

with putrid air, distend and inflate the intestines. The tongue becomes dry and foul; a kind of comatose state, a fatuitous delirium, and immense debility, succeed, under which, the patient sooner or later sinks. Fevers not only end fatally in individual patients, but the contagion is kept up, and spreads in the circle, where they are thus treated: and, the recovery of such as emerge, is unusually slow, tedious, and uncertain.

Nevertheless, opium may be of service in fevers of various kinds, in particular circumstances of irritation: but the occasion is best learnt by observation and experience.

As I know that opiates suppress evacuations by stool, I seldom order any in the beginning of fever, unless to give quiet after the operation of an emetic, or to moderate evacuation by stool, when it is excessive, or arises from too much irritability.

In a word, if any symptom in the acme of fever, or in its decline, requires a sedative medicine, I shall, on such occasions, administer opium in cautious doses. If a stimulus is needed, or a strengthening medicine, properly so called, I shall not for that purpose administer opium.

Wine, in such circumstances, is the best stimulant

mulant and cordial; and Peruvian bark, with proper antiseptic aliment, the best restorer and supporter of strength. — I am not here writing a treatise on fevers, otherwise camphor, cantharides, and others, would not have been omitted. — The sedative power in wine, bears a very small proportion to its stimulating energy: and, like the stimulating matter and power in opium, is so inconsiderable, as scarcely to deserve consideration, and to be below estimation. The excitement of the languid powers of nature, and of the nerves in low fevers, by a *discreet use of wine*, makes it highly salutary, both as an antiseptic and stimulating medicine.

28. It cannot, however, be forgot, that opium, is one of the great and important instruments of the healing art, relieves pain, and gives solace to the tortured body and mind. It gives more than relief in cholic, cholera, and in nephritic excruciating paroxysms: it is useful in the small-pox, and some other eruptive fevers; it stops or suspends hæmorrhages, gives ease in rheumatic, venereal, and many other painful diseases, which afflict mankind. — But the mischief of the alexipharmic treatment of fevers, in which compositions containing opium, indiscriminately used, were so injurious, that I thought every vestige of that method had forever been exploded; and makes me
fear

fear and suspect, renewed calamity, from this restoration of a method, somewhat resembling it: for the mischiefs of that method, did not consist altogether in the foul air of a close hot room, and in a vast load of bed-cloaths; but, in the early and promiscuous administration of compositions, in which opium was the predominant, and the most pernicious ingredient.

But ever attentive to just information, as well as to sound observation, I shall continue to use this remedy as a great medical resource; believing with *Sydenham*, “*Ita necessarium est opium, in hominis periti manu, organum, ut sine illo manca sit et claudicet medicina; qui vero eodem instructus fuerit, majora præstabit, quam quis ab uno remedio facile speraverit.*”*

I have dwelt the longer on the operation of opium, not merely because I think it misapprehended, but also because it manifests, in a clear manner, the extent of the law of sympathy.

This makes it the less necessary to enumerate all the phænomena of sympathy: those who de-

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* Opiates, by benumbing the senses, and in large doses disordering them, suppress those sensations, which show the real state of diseases; and thus delude the patient, and often deceive the physician, with false appearances of relief.

fire farther satisfaction, will find a great deal, in the excellent works of Dr. *Whytt* and Dr. *Tillot*, already quoted.

29. From the universal communication of the nerves with the great sympathetic, the eighth pair, and the brain, arises the sympathy of the head and stomach, and of the thorax with the viscera of the abdomen, and their liability to be affected with passions: on the other hand, by a kind of retrograde sympathy, the mind is sedate or agitated, exhilarated or depressed, according as these viscera are affected in health and disease.

The affections of the mind, impressed upon the features by the medium of the nerves of the fifth and sixth pairs, display, in the eyes and muscles of the face, those physiognomonic characters, which distinctly mark every passion, and each emotion of the mind, in so evident a manner, as to connect or disunite mankind; so as to inform, or create attachments, or excite aversions to one another, by a natural utterance, prior to, and more expressive than language, and artificial characters: from the former, domestic animals distinguish the dispositions of persons with whom they live, and on whom they depend.

The science of physiognomy, carried to such
whimsical

whimsical lengths by the ingenious *Lavater*, has much foundation in nature : it is doubtless subject to uncertainty, and must vary according to the experience and sagacity of the observer; and the theories of this observer, perhaps, often give a suspicious bias to his inferences.

In the action of sneezing, the diaphragm is made to contract, by the irritation of the membrane of the nostrils. A sudden tickling of the ribs, and of the soles of the feet, cause involuntary and painful laughter, that kind of emotion which has been deemed a characteristic of man, and, is ordinarily excited by sudden and unexpected combinations of pleasant ideas and impressions, upon the mind.

From the ganglions of the splanchnic nerves being affected, as other nerves often are, and, as these may be, much oftner than we are aware of, by acrimony, irritation and inflammation; wounds, or some other morbid cause, *C. Piso*, *Willis*, *Bohn*, and others, derive the source of painful cholics.

30. *M. Senac* justly observes, that in wounds of the viscera, viz. the liver, stomach, mesentery, intestines, strangulations, and severe cholics, the pulse is always uncommonly sunk and concentrated, and the force of the heart signally diminished :

nished : this is the consequence of every species of sympathy. In order to account for these effects, so frequent above all others in affections of the abdominal viscera, this ingenious writer, to whom the uses of the ganglions were unknown, was led to conjecture, that these parts had proper sympathetic nerves distributed to them, independent, and different from other nerves; and these he supposed to be the seat of such frequent sympathetic affections: the observation seems to justify our supposing, that he would not have failed to have referred that sympathy to the ganglions of those nerves, had the uses thereof been known to him.

The parts on which the splanchnic nerves are distributed, and those connected with them, eminently suffer, in hysterical and hypochondriacal complaints. In cholics from lead, and every other cause, and in the cholera morbus, the limbs are often severely cramped and convulsed; and they are sometimes left in a paralytic state, by diseases primarily seated in the bowels, more especially in lead cholics, which are very frequent in seasons when cyder is in plenty.

A person of the age of fifty years, lately consulted me for such a disease, left by a severe chollic; which came by drinking cyder plentifully, (as usual in Herefordshire,) which was made at a mill

mill mended with lead. He had very little power in his arms, his limbs were much extenuated, as well as paralytic. He received sufficient strength in them by tinct. sacrae, and tinct. guaiac. volat. drach. ii.—bis die. taken only for a week.

This is one of the many instances of the power of the poison of lead, acting backwards, from the great sympathetic nerves, to the voluntary nerves and muscles, and the effect is not uncommon.

When the mind is affected in sudden passion, the heart palpitates, and the diaphragm is irritated into quicker movements: the velocity of the blood is thus accelerated, the pulse and respiration quickened, from this and various other causes, acting in the stomach:—hence arise asthmatic paroxysms, which are often relieved by blisters, and other epispastics, applied to the back; because respiration is in part carried on by the dorsal nerves, which are connected with the intercostals.

31. As the viscera in the abdomen are all connected in the closest sympathy, by deriving their nerves from the great solar mesenteric ganglion, called by *Wrisberg*, *cerebrum abdominale*,—hence it arises, that a stone, descending from the kidneys by the ureters, diffuses severe pain in every part of the bowels, whence it is often mistaken for a common

mon cholic. — Hence vomiting is excited by the passage of gall-stones into the duodenum : — and hence the severe action of emetics, cause bile to be thrown back into the stomach from the duodenum, and to be thrown up in the last strainings, in the operation of an emetic. — The vomiting sometimes excited by a violent and cruel irritation from calculus in the urinary bladder, as well as during its descent in the ureters, and from pains in parturition, or from inflammation of the uterus in puerperal fevers, is a very dangerous symptom.

Moreover, as the lower mesenteric plexus, sends nerves to the male and female organs of generation, to the rectum and urinary bladder, and to the membranes and vertebræ of the loins : and these afterwards communicate with the nerves descending to the limbs : from this universal communication it happens, that diseases in the bowels often affect the organs of generation with painful spasms : and that pains are reciprocally excited in the back and intestines, by inflammatory tumours in the testes, and other organs of generation : and that tenesmus and irritation in the rectum, are accompanied with painful motions to empty the bladder, and vice versa. Finally, that calculi in the bladder shall not only cause uneasy itching in the glans penis, but likewise itching, and often violent

lent pain, in the feet, with tremor and horrors over the whole body.

The irritations from cancerous acrimony seated in any part, are as cruel as they are extensive. A lady afflicted with a cancerous uterus, originally complained of pains in the stomach and bowels: and at the same time was often troubled with frequent returns of severe cramps in her legs. She now complains of violent pains in the course of the nerves, and vessels under the joint of the right knee. Her inquietude, and uneasy sensations in her back, shoulders, and breast, are so great, that every thing that touches her gives her pain. Her pulse is low, quick, and unequal. Her respirations difficult, without cough; and on attempting to move, her pulse flutters as if she was expiring. The os uteri is hard, scabrous, and unequal; and from that part are diffused those irritations, which are soon to terminate in death, and which in the mean time make life miserable.—— The event happened a few months after, as here foretold.

I have done with the particulars of sympathy; and have only to add, — As the removal of pain by opium, and the refreshment of the system by wine and food, are soon communicated from the nerves of the stomach to every part: thus also, frequent returns of painful and spasmodic diseases,

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act from a part of the nervous system to the whole, and often establish a diseased habit; and pain and disease in any part, occasions them to be felt at a distance, so that the part originally acted upon, shall often appear less affected, than that which suffers by nervous communication and sympathy.

32. Dr. *Willis* and *Vieussens*, describe the uses and functions of particular nerves, with great propriety: and it has been observed by the late Mr. *John Hunter*: (and I name him, to express my esteem; and my regret, for the loss physiological science has sustained, of one who pursued that part of knowledge, with uncommon diligence.) He observed, "that the origin and number of nerves, being invariably destined for particular parts, he is persuaded, this general uniformity, in course, connection, and distribution, answers some purpose, superior to mere mechanical convenience. Many variations, described in the dissections of nerves, he believes, have arisen from the blunders of the anatomist, rather than from any irregularity in their number, mode of ramifying, course, distribution, or connection with each other." He adds: "I have no doubt if their physiology was sufficiently known, we should find the distribution, and, complication of nerves, so immediately connected with their

III.

Case of ANGINA PECTORIS, from an unexpected disease in the heart. By James Johnstone, M. D. C. M. S. &c.—First published in Memoirs of the Medical Society, London.—Vol. i. Art. 22.

Read December 17, 1786.

THE Reverend Gregory Parry, prebendary of Worcester, &c. somewhat under the middle size, with a short neck, and inclined to corpulence, of a cheerful and social temper, had enjoyed very good health till after his sixtieth year; it was some time after this, that the extracting the chrystaline humour, which became cataractous and opaque in both eyes, was performed by Baron Wenzel, so as to secure him the sight of one eye to the last. He found the sensation during the operation, like an uneasy tickling, rather than pain,

ANGINA PECTORIS. 191

pain, properly so called, and went through it with spirit.

He consulted me in the summer of 1783, for a pain in his stomach, which seeming to be only flatulent, and to arise from indigestion, easily yielded to draughts of the warm stomachic kind, with *tinctura sacra*; returns of such uneasy feelings in the stomach, were not unusual, nor unfrequent after this, but always yielded to the use of these draughts. He had, at this time, a pulse remarkably slow, though very regular, which made me intimate to his family, considering his make and age, the propriety of precautions, if any thing like giddiness, or pain in the head, should appear to threaten apoplexy. Nothing, however, of this kind happened; and no appearance of symptom suggested his having the *Angina Pectoris*, till after his return from a visit to London.

In June last, he complained of shortness in breathing, with pain in his chest and across his arms, on walking, especially up any ascent; and of such complaints he had frequent returns, in the months of June and July, notwithstanding bleeding, a brisk cathartic or two, and some other medicines were ordered, besides the repetition of the stomachic draught, of which he had a good opinion, from the relief he had received

ceived from it: and now, I plainly saw he was affected with a disease, which has proved so constantly fatal, and expected, sooner or later, to hear of the sad event.

Just before he left Worcester, he had a short and slight fit of the gout, which seemed to relieve him, and gave me some encouraging hope: indeed, he remained free from this complaint till he had been in Wales; but a short time afterwards, the fatal symptoms returned, more than once, previous to the attack, which suddenly ended in death.

That evening, the 2d of August last, he seemed cheerful and well; but after being some time in bed, he complained he was very ill, and sat upright in it; but after his *tinctura sacra* draught, he seemed easier, and Mrs. Parry heard no more complaint till some time afterwards.

Early in the morning of the 3d of August, she was roused by the noise of his expiring groan: in fact, he was dead in an instant; and, I believe, had entered the seventy-first year of his age.

His body being opened the 4th of August, by Mr. Gunter, surgeon, in Brecon, the following is a very sensible account of what he observed, which I give in his own words.

“ SIR,

" SIR,

" AT the desire of Mrs. Parry, I beg leave to inform you of the appearances attending the dissection of the late Mr. Parry. The intestines were in a natural state, but much inflated with wind; stomach covered with a very black mucus, quite empty, very much discoloured, in many places black, particularly about the *pylorus*; the blood-vessels over it very much distended; the liver indurated in every part, but mostly so about its edges; the heart very putrid, admitting my fingers passing through it with very little pressure, it was quite empty, and the vessels going to and from it, perfectly sound, and no ossification; the lungs sound, not even an adhesion; the *pancreas* somewhat hardened; kidneys very much diseased, hardened in every part; the *pelvis* with difficulty distinguished, it was covered very much with fat, highly tinged with bile:—these are the whole appearances.—He was not my patient, otherwise I should have examined the head; but the gentleman under whose care he was, did not chuse it: from the dissection, perhaps, it may be difficult to assign the immediate cause of death. If the above account can contribute to throw any light, or give you some satisfaction, I shall think myself happy in sending it; and am,

your most humble Servant,

W. GUNTER."

Brecon, Oct. 2, 1785.

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This dissection shews another almost unsuspected cause of sudden death. — This gentleman laboured under, first, the complaints of indigestion, a flatulent pain, with which he had been long troubled, before any symptoms of *Angina Pectoris* were heard of; to such complaints the disordered stomach, the discoloured *pylorus*, inflated intestines, and even hardened liver, (he had no icteric colour,) have an obvious and close connection.

Secondly. — The symptoms of *Angina Pectoris*, which troubled our patient in the last three months of his life, plainly arose from, and were symptoms of, defect of power in the heart. From what causes, or cause, the putridity, or disposition to mortification, which seized this vital muscle, arose, may not be very clear; but that such a state must render it unfit for its office of carrying on the circulation of the blood; or, in other words, of supporting life, must be evident.

The heart being insensible, even its diseases are attended with no proper sense of pain, peculiarly felt at this part; a thousand experiments, as well as accidents and cases, have established this fact: but that peculiar sensation of weight and agony, with difficult breathing, and, pains extending to the arms, and pectoral muscles, on attempting to move; in short, a sense of failing life, when the

the heart, from any disease affecting its mechanism, and disturbing its motions, is hindered in distributing or propelling the blood, through the pulmonary artery and lungs, into the left ventricle of the heart, and from thence into the aorta and the whole body, seem to be the symptoms of danger in this organ. It is in this state so immediately threatening to life, in this convulsive, agonizing struggle for existence, that the cardiac nerves, derived from the thoracic ganglions of the great sympathetic nerves, are stimulated in an extraordinary manner indeed, and that all the wide-extended connections of the sympathetic nerves, particularly those in the chest and superior extremities, are irritated thereby into painful spasms, such as are felt in the *Angina Pectoris*, though least of all felt, in the organ from whence they originate, the heart itself.

I think it quite unnecessary here to shew, from approved anatomical works, that the cardiac nerves have the origin and connections here taken for granted. I suppose my readers neither to be ignorant nor captious. My learned friend, the late Dr. Wall, reasons in the same manner. See *Med. Trans.* vol. iii. also, *Lancisi de motu cordis & aneurismatibus*, *Vieussens neurographia*, and the tables of *Walther* on the *Visceral Nerves*.

But inteneration of the heart from putridity, sometimes has been the occasioning cause of sudden death, by rendering the ventricles of the heart liable to rupture: of this accident our late sovereign *George II.* died at an advanced age; and in a Memoire, by *M. Morand*, in the *Memoires de l'Academie des Sciences de l'an 1732*, concerning remarkable accidents in the organs which carry on the circulation of the blood, he mentions the case of the Dutchess of Brunswick, who died of a rupture of the right ventricle of the heart, in 1730; and that of a person of condition, examined by himself, who died the same year, of a rupture of the left ventricle of the heart: and he adds, “ Pour
 “ expliquer comment, dans les deux cas que j’ai
 “ rapportes les ventricules du cœur ont pu s’ouvrir
 “ sans cause exterieure, il faut remarquer que dans
 “ le premier, il y avoit une erosion aux fibres char-
 “ nues du ventricule droit, qui sembloient avoir ete
 “ ulcerees & creusees peu a peu jusqu’ au trou qui
 “ ouvroit le ventricule; et que dans le second, le
 “ chair du cœur etoit devenu molle au point qu’
 “ en quelque endroit qu’ on presentat le bout d’un
 “ sonde, sans l’appuyer, elle entroit & traversoit le
 “ cœur par le simple poids, de l’instrument qui
 “ n’est pas considerable.

“ Donc la rupture de cet organe sera raisonna-
 “ blement attribuee a l’amollissement de ses fibres
 “ ou

“ ou a un ulcere qui en aura use' l'epaisseur. On
 “ trouve plusieurs exemples de l'ulcere, dans le
 “ Recueil de Bonetus, mais un seul de la Mo-
 “ leffe.”

The enlarged bulk and weight of the substance of the heart, is sometimes suddenly fatal, as well as its rupture: such a case is quoted by *Lancisi*, from the Chirurg. Observ. of *P. Marchetti*. The patient seems to have laboured under the symptoms of the *Angina Pectoris*, as they are exactly and eloquently described by Dr. *Heberden*. The heart was found three times its natural size, and the pericardium adhered in many places to the pleura, and even to the diaphragm, so as to weigh it down, and occasion a fulness in the hypochondria.

A corpulent gentleman, aged seventy, who had been for some time troubled with asthma and pain in his chest, and died suddenly, being opened, ossifications were found in the aorta, and the basis of the heart; its bulk and weight increased by an unusual quantity of fat: such also seemed to be the cause of the sudden death of *C. B*—; for the heart and abdomen seemed covered with more fat than Mr. *Causser*, a skilful surgeon, who opened the body, had ever seen.

Besides these causes of *Angina Pectoris*, ossifica-
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tions of the valves of the heart, polypose concretions in its ventricles, extending far into the great vessels; water, blood, and purulent matter in the pericardium, mediastinum, or cavity of the thorax, have produced it: and the same sudden termination of life, will often be brought about by causes acting on the living nerves, which leave no morbid appearance in the vital organs, distinguishable after death by dissection.

Aneurisms, ruptures, and other fatal diseases of the heart, are often caused by fear, sudden passion, oppressive anxiety, and other vehement emotions of the mind, often indulged. I recollect several persons who had the *Angina Pectoris*, and who died suddenly, to have been of this kind of disposition. The government of passion is, therefore, to be considered as necessary to prevent this catastrophe, as well as to secure general ease and health. Far be it from me, to wish to banish from the breast its most engaging feelings, and to plant instead, the unfeeling torpor which insulates individuals, and makes them unaffected and indifferent to the interests, the woe, or happiness of mankind. Such was not my deceased friend. I only wish to regulate, and temper this amiable warmth of soul, and to keep in view a fact, that the heart is an involuntary organ. Volition has no power over it, and unimpassioned thought does not affect it; but the frequent

frequent repetition and long indulgence, in vehement and uneasy passions, have often created the most fatal diseases in this part.

This survey of some of the causes of *Angina Pectoris*, shews why it is so generally an incurable and mortal disease, and yet points out the expediency of attempting a cure, in some cases and circumstances; and, in all cases, the duty of attempting to put off the fatal hour, by prudent methods of prevention and palliation, by sobriety, and regularity of life and diet, guarding against excesses of every kind, which may create indigestion, or too much distend the stomach, especially at bed-time; for in a decumbent posture, the pressure of a stomach over-filled, as well as its uneasy, irritated state, must create very dangerous obstacles to the circulation of the blood, when any disease in the heart renders it already too unequal to its office; obviating fulness of the blood-vessels, by seasonable evacuations, and by keeping the secretions open: avoiding hurry, and excessive accelerated motion, by hard exercise; yet supporting the strength and spirits, by being much in the open air, and on horseback, and much too in the society of cheerful and easy companions.

Worcester, Dec. 1, 1785.

IV.

An Account of two extraordinary Cases of GALL-STONES. By James Johnstone, M. D. of Kidderminster. — Communicated by the Rev. Chares Lyttelton, L. L. D. Dean of Exeter. — First published in *Phil. Trans.* — Vol. 1. p. ii, p. 543. — 1758.

Read February 9, 1758.

To the Rev. Dr. Lyttelton, Dean of Exeter.

Rev. Sir,

ACCORDING to my promise, I send you a short account of the two extraordinary cases we talked of, the last time I had the pleasure of seeing you at Kidderminster.

The truth of the first narrated case, you are already

ready a sufficient judge of; and if it is at all necessary to ascertain the second in like manner, I can, at any time, produce the poor woman and her husband before you, who will attest the truth of sufferings, which will not easily escape their memory.

You are at liberty to dispose of this paper as you shall think proper. I am,

Reverend Sir,

Your respectful and most humble Servant,

J. JOHNSTONE.

Kidderminster, Sept. 11, 1757.

THOUGH it is now pretty well known, that cholicky and icteric diseases, often arise from gall-stones, generated in the bilious receptacle, and obstructing its canals; yet an example of one, of such enormous size, voided into the *duodenum*, from the *ductus communis*, as happened in the first of the following cases, is very rare, if not entirely an unexampled occurrence. It will encourage us not too easily to despair of the expulsion of the largest *calculi* from the gall-bladder; and will teach us, that

that all violent attacks of pain about the stomach, are not owing to gout reflected upon that organ: it will make us more cautious of giving drastic cathartics, heating and inflaming medicines, upon such a vague presumption; and ought to dispose those, who are trusted with the lives of their fellow-creatures, to a nicer observation, of even the minutest symptoms and circumstances, which may occur in diseases.

The second case points out, under certain circumstances, the practicability of extracting, by incision into the gall-bladder itself, those *calculi*, which, from their figure, or other impediments, cannot be voided in the natural way. The method of performing this unusual operation, and some instances of its success, have already been made public, in the *Memoires de l'Acad. de Chirurg.*

1. Mrs. *Floyer*, wife of the late alderman *Floyer*, of Worcester, a sedentary, corpulent old lady, had been much subject to cholicky complaints, without jaundice, in the vigour of life. The seat of the pain was chiefly under the right *hypochondrium*, as high as the stomach. She had been tolerably free from it, for at least eight years past. December 5. 1753, about eleven o'clock in the evening, she was suddenly seized with a violent pain, extending
from

from that part of the stomach lying under the right side, through to her back. She compared it to a sword driven in that direction. This pain continued, not only with unremitted violence, but even increased, till seven o'clock in the morning: all this time she vomited and strained almost incessantly; but after her stomach was emptied of its contents, nothing came up besides clear slime, streaked with blood. About seven o'clock in the morning, she felt her pain fall, or move lower, as she expressed it, and from that time became remarkably easier. Soon after this change, she became extremely sick, and vomited up, for the first time, a prodigious quantity of greenish yellow bile. She had not, before this seizure, been remarkably costive; and in her pain had a free motion to stool, with effect; but during the remainder of the (6th) day, had none, though all this time emollient clysters were injected; and she took regularly, every two hours, a powder of *magnes. alb. terr. fol. tartar. tart. vitriol. ana scrup. j. ol. nuc. mosch. gutt. j.* with a draught of the *succ. limon. & sal. absinth.* But in the middle of the night, and all day, (the 7th,) she had an abundant discharge of loose bilious stools. She had continued free from excessive pain, since the morning of the former day, only now and then complained of uneasiness, sometimes in one, sometimes in another, part of her bowels. About twenty-four hours

hours after her first seizure, she felt a great pain striking towards the bottom of her back, and one hour after, voided the extraordinary *calculus*, of which the figure and description are subjoined. Some time after, pieces of skin were voided by stool, which were evidently of the texture and appearance of the internal villous coat of the intestines and gall-bladder. The above medicines were the only ones she used, by my direction, under her painful complaint, excepting an external fomentation and bleeding, which the hardness and contractedness of her pulse seemed to require. She was ordered to drink plentifully of thin broths, and other soft diluent liquors. During the course of her disorder, she had no appearance of jaundice, nor since; and, considering her years, enjoys at present (Sept. 1757,) very good health.

This *calculus*, as appears by the figure, was of a pyriform shape, resembling the form of the *cystis fellea* itself. Its surface was quite smooth and polished, excepting towards the base, at that part marked A, where it was scabrous, as if some other substance had lain contiguous to it. When broken through, it was composed of concentrical laminæ, which were alternately white and ochre-coloured. In length, it measured one inch and three-tenths; its transverse section measured at least seven-tenths of an inch. It had a saponaceous smoothness, like other gall-stones, and floated upon water. It weighed

Howell's shell.



A



Rogers' shell.

weighed only about one hundred and twenty-six grains.*

Though it be difficult to conceive, how so bulky a substance, generated in the gall-bladder, could be conveyed along so narrow a passage as the common biliary duct, especially considering the obliquity of its insertion, for near half an inch of length, betwixt the coats of the *duodenum*; yet there seems sufficient *data*, in the above case, to prove, that this animal stone was not formed in the alimentary tube, but (large as it was) had come into it from the *ductus communis choledochus*.

The shape and saponaceous smoothness, and colour of the lamina, of this substance, shew it was moulded in the gall-bladder, and formed from bilious particles. The severe pain and torture, and enormous vomiting, she underwent, for seven hours after her first seizure, argue, that it must then be lodged in some canal, much narrower and straiter than the alimentary canal; for, so soon as it dropped into that, the severe pain, in a great measure, ceased.

But that strait canal, in which it was situated during those seven hours of torture, could be no other than the *ductus communis choledochus*; for, during

* Figure 1. shews the size of the entire stone—a and 3, its variegated laminated appearance when broken in two pieces.

during this space of time, no bile was emptied into the bowels, nor thrown up by the strongest efforts of vomiting: but no sooner had she perceived the cause of her pain to move or drop downwards, (a sensation, which points out the precise moment when the stone must have dropped into the *duodenum*,) than she began to sicken, and instantly after vomited up a large quantity of bilious matter, which now, from the de-obstructed duct, began to flow freely into the *duodenum*. The obstruction of the *ductus choledochus* was of too short a duration, (only seven hours,) to occasion any observable jaundice. And it appears by the bloody flesh-like knots, thrown up with phlegm, by vomiting, that the passage of the substance was not effected without considerable laceration of the small bilious ducts. And this easily accounts for the separation of the villous coat, which afterwards appeared in this patient's stools.

The annexed delineation represents the figure and true bulk of the *calculus*. — See plate, 1, — 2, — 3.

2. In February, 1752, I was called to relieve a poor woman of this place, *Sarah Ewdall*, aged thirty years and upwards, and the mother of several children. She laboured under the jaundice, and complained of a severe, acute pain, striking through

through from the right *hypochondrium* to her back, with frequent vomitings. A præternatural hardness, of a compass not exceeding the hollow of the hand, was then plainly to be felt at the pit of the stomach, or a little nearer to the right *hypochondrium*. When that particular part was pressed, she complained of great pain. The pain at this part was always increased, by attempting to lie upon the left side. She was blooded, fomented externally, had emollient saponaceous clysters injected, and a nitrous apozem, and pills composed of *galban.* & *Jap. Castillens.* and soon after recovered. She had frequent returns of the same complaint, after this; but I saw her not again till January, 1755, when she lay insensible in a fit, which for several days deprived her of the use of her speech, and of all her senses, only she tossed her limbs about. About a quarter of a year after she had recovered from this fit, Mr. Cooper, of this place, her apothecary, informed me, that from a small sore at the pit of her stomach, which came since her last illness, she had voided several gall-stones. Curiosity prompted me to inquire into the matter of fact from herself. She shewed me the sore, which was now almost cicatrized. She said, that soon after her last illness, a little pimple arose upon that part of the pit of the stomach, which had been hard ever since she had been subject to the jaundice. This pimple broke, ran matter, and at
different

different times the *calculi*, which she shewed me, had come out with the matter. Her stomach had been somewhat painful before it broke, but was now easy. The *calculi*, which she shewed me, had the appearance of being fragments of larger ones, and some were almost dust; though she assured me, they all came from the sore in that condition. Of these fragments, I have two or three of the largest now in my custody: they are light, swim on water, smooth like soap; are of a yellow colour, and in some parts brown, like snuff; and consist of similar concentrical layers. The poor woman has, since then, been troubled with returns of pain and jaundice, in the intervals of which, her skin is perfectly clear and white. She is still alive, and ready to attest the truth of this narrative.

J. JOHNSTONE.

Kidderminster, Sept. 11, 1757.

This woman died in 1763, of what disorder I know not, as I did not afterwards attend her.

History

V.

History of a Fœtus born with a very imperfect Brain.

By James Johnstone, M. D.—*First published in Phil. Trans.—Vol. lvii. p. i. p. 118.—1767.*

Read March 5, 1767.

IN October 27, 1765, a monstrous birth was brought me by a midwife of this place. It was a female child, come to its full time, in which the whole scull, excepting its basis, was wanting: this was covered with something which had the appearance of red flesh. I found it to consist of different membranes; and in a small depression, in a back part of the basis of the scull, lay the brain, such as it was, not exceeding the size of the kernel of a filberd nut, flaccid and membranous. I could not have positively pronounced it brain, had I not traced its continuation into spinal marrow, down the channel of the vertebræ. The eyes were perfect

P

fect and found. The optic nerve of one eye I examined, though not large enough, yet in thickness was almost equal to one-third of the spinal marrow, which was too small likewise.

Upon opening the breast and abdomen, all the organs contained therein, seemed in structure perfect, properly situated, and full grown. The heart in particular, was plump and strong. This infant had not breathed; its lungs, which were perfect, sunk in water: yet the mother and midwife, felt it active and strong, just before delivery.

This child had tongue, nostrils, eyes, and ears, and every other part, excepting the brain, perfect and plump, as in the healthiest infants, come to their full time.

Many births similar to this, in most circumstances, are recorded in the Transactions of the Royal Society, No. 99, 226, 228, 242.

1. Such of them as were born alive, died soon after birth, though lively and strong in the womb. And perfect in all parts, the brain and scull excepted.

2. In that of which an account is given by Dr. Preston, (Philos. Transf. No. 226,) the celebrated anatomist,

anatomist, *Monf. du Verney*, traced the eighth and ninth pairs, the medulla spinalis, and the intercostals. The child was well proportioned; the cranium, brain, and cerebellum, were wanting; in lieu thereof, remained only a substance, like congealed blood, covered with a membrane.

3. In a case related, and largely commented upon, by the celebrated *Wepfer*,* which differs in many respects from other children said to be without brains, the child was well proportioned, its head of the usual size, but its brain had degenerated into vesicles, or hydatides, each of which had its blood vessel, (might one from thence infer, the natural state of the cortical substance of the brain to be cellular?) and the optic and auditory nerves took their rise from three portions of medullary substance, lying upon the sphenoid bone near the sella equina.

4. These singular existences afford useful inferences, and shew, that the irritability of the heart is capable of being sustained, by very low degrees of the nervous power, while that irritability is kept up by the fostering heat of the mother. This feeble life is soon extinguished, when the influences of the mother's warmth and circulation cease. (No. 1.) Such infants die as soon as born, or soon after.

* *Manget Biblioth. Anat. Vol. li. p. 339.*

5. Such examples, more consequentially than experiments, demonstrate that the spinal marrow is the principal origin of the intercostal nerves; (No. 2.) and, better than ligatures, illustrate their vast importance.—For,

6. From the plump state of the body, and vigorous appearance of the heart, it is evident the circulation, and the developement of the several organs, had been carried on properly in the fœtus; and that the irritability of the heart, derived a sufficiency of nervous influence from the intercostal nerves, and its ganglions, and, these again from the spinal marrow, for growth, and that state of existence.

VI.

*Of the appearances of URINE, in diseases attended
with a state of blood tending to putrescence. By
James Johnstone, M. D. of Kidderminster. —
First published in the Medical Museum. — Vol. ii.
p. 511. — 1763.*

IN the malignant feverish disorders which have often fallen under my care in this neighbourhood, from the years 1752 to 1757, I have almost constantly observed that the Urine was turbid, or dropped a copious sediment very early in the disease, without the least amendment in consequence thereof; and that afterwards, when the disease was abating, and in its decline, the Urine then became clear, without being followed by any relapse.

Finding it difficult to reconcile these phenomena with the observations of the ancients, as they are

usually interpreted in the schools, I then began to be persuaded, that this turbid appearance in the Urine, might indicate a dissolved and putrescent state of the fluids, both in acute and chronic diseases. I reasoned thus :

“ In continual fevers of the inflammatory class, a crisis is most probably brought about by a resolution of the too dense particles of our fluids, analogous to that, which, carried to excess, causes often malignant, putrid, petechial fevers : of this salutary resolution of the morbid matter, in inflammatory diseases, (or such as are attended with a dense state of the fluids,) a sediment in the Urine is an effect and sign.

In putrid fevers, the blood is still more melted down ; and the putrid matter, being more copiously mixed in the Urine, gives it that turbid appearance, sometimes with, and sometimes without, a sediment ; which appears generally in the very beginning of such fevers, giving a very dubious omen of their event : but a turbid Urine, shews a greater degree of dissolution in the humours, than a mere sediment, which must be denser than those particles which remain mixed in the Urine. A clear yellow Urine, at or after the height of these fevers, is rather a salutary and promising appearance in them, shewing the contexture of the blood

is

is as much inspissated, as the health of the individual requires, and that the dissolved and corrupted parts of the fluids, or the morbid matter of these fevers, in other words, is thrown off or altered.*

The observations which I have made since, in all the different species of putrid diseases, perfectly confirming and agreeing with the above, have made me no longer doubt, but that a turbid, thick, or settling Urine, is as much a characteristic of a putrid tendency and disposition in the fluids, is as invariably connected with such a condition of the blood, as a limpid Urine is with spasms; and that without a fever, such a foul, turbid Urine is, as very celebrated writers have affirmed, a diagnostic sign of the scurvy; and that with a fever, especially in its increment, or without remission, it shews the fever to belong to the putrid class, in which the texture of the blood is running into putrescence and dissolution, from some general apt cause, or topical fomes.

Generally speaking then, whatever the disease be which is attended with a very foul, turbid Urine, the disease still subsisting in its vigour, it may be presumed to arise from a dissolved, putrid

P 4

crasis

* See an Historical Dissertation concerning the malignant Fever of 1756, &c. at Kidderminster.

crasis of the blood, and we may conclude it to be one proper sign of putrid and malignant fevers.

In this class of fevers, such an index of the blood's state is more particularly useful and deserving of attention, as venæ-section is, for the most part, in such circumstances, a dangerous practice.

If the relation of a thick Urine to a corrupted blood, needed any other proof than faithful observations made in diseases, this might be drawn almost to demonstration, from easy experiments upon the Urine itself; for the clear Urine of the most healthful person, standing in a room moderately warm, about the fifth day, smells highly putrid, and at the same time is become turbid, with a scum on the surface, and a sediment at the bottom of the glass: it resembles the Urine of persons labouring under putrid fevers, and a scorbutic habit; and this imitation may be rendered more exact, by mixing at first a little pus with the recent Urine.

The same truth might be supported by facts, related in the works of Dr. *Huxham*, as well as in those of more ancient observers, of the best credit; but I shall, instead of a great variety much to our purpose, now only quote a paragraph in the seventh

seventh part of the *Ratio Medendi* of the justly celebrated *De Haen*; a more extraordinary case is hardly to be met with.

“ A young man, twenty-four years old, on the 12th of December, 1761, had the trunk of the femoral artery intercepted by ligature, for an aneurism; with much care, he recovered the warmth and perfect use of the limb: the patient was for three or four months threatened with frequent returns of gangrene, for which the bark was liberally used, both internally and externally; it was used internally till the month of August following.” *De Haen* took notes of the various appearances of the Urine, in the whole course of his attendance upon this patient, and that more than once, every day. “ The day before the operation was performed, the Urine was thick, and continued in that condition for ten days after: from the time he used the bark, the Urine was less turbid, and sooner settled, but was unusually high coloured.

“ January 2d and 3d, things going on well, the Urine had a natural appearance; but on the four subsequent days, degenerated into the former state. From January 8th, the Urine was redder, with a thick whitish sediment, which soon subsided, with a furfuraceous appearance near the surface,

face, and this was covered with a pinguious pellicle, which in different lights appeared yellow, reddish, purple, and green: while the Urine was in this state, the quantity of pus was great for the compass of the wound; and that which came from its more sinous recesses, was fetid.

“ January 14th and 15th, the pus voided was little in quantity, and hardly fetid; the urine also had scarce any sediment, scarce any pellicle, scarce any colour, but what is natural; when the gangrene afterwards appeared with feverish shiverings, the Urine again was thick, turbid, and covered with a scum as before; and after it had stood longer, dropped a thick sediment: when the gangrene was stopped, the Urine was turbid indeed, but presently settled, with very little scum, and at length almost became natural.

February 28th, a feverish horror ushered in a great gangrene, the Urine became again thick, turbid, furfuraceous, and covered with a scum as before: while we were long ineffectually struggling with this gangrene, by increasing greatly the doses of the cortex, we were surprized to find the Urine appear natural for three weeks together, excepting only twice. Natural, I call the Urine, because it only differed from the natural, by the addition of a thickish suspension, or nebula, with a little farina in it.

“ The

“ The cause of this digression is, if possible, to illustrate the intricate doctrine of Urines: but how obscure, how abstruse, how inexplicable is it! The Urines observed some kind of explicable order to the end of the last gangrene, none after; by the help of the cortex in the early gangrenes, they changed for the better; after the last gangrene, though the bark was still continued in the same dose, the Urine was surprisingly various. But whence were the Urines so often turbid and jumentose? In fevers, such appearances denote obstinate crudity, with a beginning, but vain effort to produce coction; but here they denote a gangrene and sphacelus: such a pellicle as here appeared, is said to preface scurvy and calculus, but in this case, it always attended mortification.”

If it should appear that these phenomena in the Urine, which so much perplexed this learned, this ingenious author, arise from some degree of putrefaction in the blood, and are signs of it, and that this putrescence is, in a certain measure, the common cause of scurvies and putrid fevers of various kinds, and, in a higher degree, of gangrenes, we apprehend the principal difficulties attending the explanation of Urines, in such cases, will vanish, as well as many others, attending the doctrine of crudity and coction in general.

Kidderminster, Oct. 16, 1763.

CASE

The cause of the disease is, if possible, to
ascertain the nature of the disease; but how
obvious, how abundant, how much it is in. The
Chinese observed some kind of epidemic order to
the end of the last century, none after; by the
help of the context in the early centuries, they
changed for the better; and the last generation,
though the part was still continued in the same
disease, the disease was surprisingly various. But
what was the cause to often rapid and ja-
undice? In fever, such appearance denotes disti-
nction, with a beginning, but vain effort to
produce action; but how they denote a gangrene
and phlegm, such a phlegm as has appeared,
is said to purge slowly and calmly, but in this
case, it is a attended mortification.

If it should appear that these phenomena in the
Chinese, which so much perplexed the learned, this
ingenious author, with some degree of per-
fection in the blood, and are signs of it, and
on this evidence is in a certain measure, the
common cause of leucis and purid fever, of
various blood, and in a higher degree, of gan-
grene, we apprehend the principal thing was in
finding the explanation of Chinese, in such cases,
will vanish, as well as many others attending the
disease of epidemic and action in nature.

Chinese, 17. 1. 1. 1.

VII.

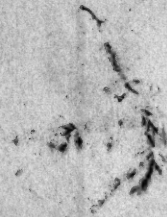
C A S E

OF

GEORGE

LORD LYTTELTON.

1836



GEORGE
WILLIAMSON

C A S E
OF
GEORGE LORD LYTTTELTON.

LORD LYTTTELTON, whose case, and the last illness which terminated his valuable life, (I am about to describe, from notes set down at the time,) was born at the end of the seventh month of pregnancy: and the delicate-frame of body which he brought into the world, in a great measure, accompanied him through life.

His make was tall and slender, very remote from being robust. He had been often incommoded with attacks of encreased secretion of bile; yet by temperance, and proper management, he arrived at the sixty-fourth year of his age, not
only

only with a tolerable share of health, but with a considerable degree of enjoyment; notwithstanding various occasions of uneasiness, and domestic disappointment, which had occurred to him.

His mind, magnanimous, and firmly religious, was besides supported, by his mental and literary amusements, his social enjoyments, his public duties, and his learned labours. The solace of the *Cicero's*, the *Raleigh's*, and *Clarendon's*, under the pressure of misfortune, was also that of this great and good man.

When he came to his country seat, in July, 1773, he complained, that for six weeks before he had generally passed his nights in a sleepless state; that he felt a debility and languor gradually encreasing, with want of appetite, yellow icteric urine, a white tongue, a weak pulse, but scarcely quick, or feverish. He complained also of a flatulent and tense abdomen, and withal of dyspnea.

To remove these symptoms, I ordered fifteen grains of powder of rhubarb, at bed-time, in a saline draught; and a stomachic mixture at noon.

July 27. Finding some increase of bilious and feverish symptoms, I ordered the following, two successive mornings.

R. Infus.

R. Infus. fennæ commun. unc. ii.

Aquæ menthæ pip. simplicis. unc. i.

Pulveris rhei, tartari vitriol. aa. scrup. ii.

Sacch. alb. cortici limonum attrit. drach. ii.

M. f. haust. No. ii.

He had besides, twice in the day, a saline draught of succus limonum, with sal. absinthii in a state of effervescence. He took four of these.

August 1. His urine was now of a natural colour, and his belly less tense; I ordered twenty drops of acid elixir of vitriol, to be taken twice daily, in a glass of water; and three of the following pills at bed-time.

R. Gumm. ammon. drach. i.

Pil. Rufi, femi drachmam, f. pil. xviii.

August 9. His Lordship returned from a visit to Sir *Edward Lyttelton*; and had taken his last ordered medicines.—He had been better, but his sleepless nights had not left him.—In all this time he had only one good night: in every other night, he was constantly disturbed when going to sleep, by palpitations, and short breathing.—His pulse, in all this illness, irregular.—His urine bilious and high coloured: his tongue white, his eyes and skin brown: his stools always of a chocolate brown colour,

Q

lour, never inclined to white. — Beginning to dislike his opening draughts, he took instead, a quarter of an ounce of cream of tartar, in barley water, in the morning; and twenty drops of acid elix. vitrioli, in Pyrmont water, twice in the day. — At night, ten grains of rhubarb: by this course, he was kept open the whole of this week. — His urine and skin acquired, at times, their natural colour. But his sleep was every night interrupted by palpitations, and shortness in breathing, though, in the day, free from these symptoms.

I dined with him the 14th of August, the last time he saw company: he had been very languid in the morning; after dinner, and a few glasses of wine, he grew cheerful: I urged his taking a little fruit, and a glass or two of wine at supper; to try if a fuller diet could dispose him to sleep; but this had no better effects, than his spoon meats, and stricter diet, which he had observed for some time, while he was taking his opening draughts: his sleep continued to be interrupted: and though the bilious symptoms seemed subdued for a time by his medicines, yet they still returned, and instead of regaining strength, it continued to sink.

August 16, I found the supper and wine allowed, had in no degree contributed to remove his Lordship's restlessness, — He never slept at night, without

without the ominous interruption, by palpitations and short breathing, already mentioned. — The bilious appearances in his urine returned, his tongue was white, his eyes were yellow; his pulse low, irregular, and rather too quick: the liver felt a little hard, and the hypochondrium tense.

Hitherto opiates had been avoided, as it was apprehended, they might interrupt the efficacy of the means, by which the biliary ducts were to be opened, and the superfluous gall carried off. — But as the use of gum ammoniac and camphor, in pills, had failed to produce rest, and as increasing debility, and universal hurry of nerves, were the consequences of the want of sleep: 'twas now thought proper to give an opiate at night, and to persist in the use of the aperient, and deobstruent medicines in the day, to such a degree, and in such doses, as should keep the body open; this evening he had a draught, with twenty drops of laudanum in tinct. sacra. — He rested well, and was much refreshed in the morning. But the same draught had no such effect the night of the 17th, — he had then no rest, his breathing was short, and palpitations as great as they had ever been.

Stools were procured by the means already ordered, and by chamomile glysters, thrown up two or three times a day.

18th. I prescribed pills with camphor, rhubarb, and assaetida: he took them, though with much reluctance and disgust, as the smell of assaetida was particularly disagreeable to him: — He had purging stools, but began to be fainty, and his pulse very low, as well as irregular, with cold clammy sweats over his body. — This evening, he had two or three doses of tinct. thebaica, of twenty drops each dose, and had some refreshing sleep: his pulse was found regular, while the effect of the opiate lasted.

19th. When he got up, he was depressed, faint, and sick, and had a coldness all over him: this was supposed to be an effect of the opium. — I encouraged him to vomit, with chamomile tea; he threw up some yellow bile, and his sickness seemed removed by it.

20th. He took, in distinct doses, near 120 drops of tinctura thebaica this night, but without procuring rest: — the lowness of his pulse, depression, palpitations, and prostration of strength, very great. A vomit of ipecac. wine, and antimonial wine, was taken, but very little bile was brought up by it.

He had taken the tinctura sacra, to day, without procuring stools: this evening, he took twenty grains

grains of pil. Rufi. and twenty-four drops of tinct. thebaica, with ten drops of spir. vol. aromat.—this last dose was repeated four times this night ineffectually: the pil. Rufi. was repeated in the morning.

21st. At my desire, Dr. Afb was called in to my assistance. His Lordship had slept from five to eight o'clock in the morning: he was then warm, his pulse stronger, though irregular, and he was now free from shortness in breathing and palpitation. The Doctor and I agreed in the indications, to clear the biliary ducts, and carry off bile; and the following draughts were prescribed by us.

R. Tinct. sacra spir. unc. fs.

Aq. menth. pip. simpl. unc. i.

Tart. vitriolat. scrup. i. Sal. abfinth. gr. iv. f. haustus—to be repeated once in four hours: and extract thebaicum, was ordered to be taken at night, and chamomile glysters to be occasionally injected.

The remission of symptoms, during which these measures were directed, soon ceased; and by the encouragement of my assistant, his Lordship took cordials, brandy and water, and citron water, in considerable quantities, but was very little relieved by them. The extractum thebaicum procured no

rest this night; and he had the additional symptom of much thirst.

22d. About noon, his Lordship found his dyspnea, and hurry return: about six o'clock in the evening, he was seized with the rattle in his throat, and with an universal coldness. He found himself a dying man, and expressed his belief, of that being his situation, with great resignation, and instruction to all around him! He continued to drink citron water, and brandy mixed with water, with drops of spir. volat. aromaticus. Blisters were applied, one to his stomach, and another to his arm, near the axilla. But the alarming symptoms continuing, three whole papers of *James's* powder were administered in the night; and a very free evacuation by stool followed in the morning: but the sweats continued cold. In the forenoon of the 23d, he recovered his heat, and he breathed with less difficulty; and he now swallowed old hock, and other drinks. He was better, but to no such degree as encouraged *me* to expect amendment, much less recovery.

This evening the bad symptoms returned: he again repeated two or three whole papers of *James's* powder, but no evacuation followed; and his abdomen, notwithstanding former evacuation, became more tense, and tympanitic. His cold sweats returned,

returned, and he died about seven o'clock in the morning of the 24th of August, 1773.

He was opened by Mr. *Causar*, surgeon to the family. — The brain was not examined: the liver was found hard and enlarged, but no pus was observed in it. The gall-bladder was distended, and full of black bile: bile abounded in the duodenum, and the adjacent parts were very much tinged with it: — the gall ducts were found free from obstruction. In the thorax, the left lobe of the lungs adhered to the pleura almost in every part: the lungs of the right side were free from adhesion: — no polypus was found in the heart, or great vessels: no water in the pericardium or thorax — no adhesion of the pericardium to the heart: no ossification in the heart. — In the abdomen, some adhesions of the intestines to the ^{transverse} pericardium were observed in the left side of the body.

His Lordship's bilious and hepatic complaints, seemed to me inadequate, singly, to the production of this fatal event.

In dissection, no sufficient cause, no morbid state, appeared in the thorax, which might have

caused the palpitations, dyspnea, and fatal interruption of sleep.

These symptoms, arose most probably from an exhausted state, and defect of nervous power, which can never be visible in dissection.

Irritations, attending a debilitated state of nerves, are often the cause of bilious symptoms.

The want of sleep, for so long a time, whatever might have been the occasion of that, sufficiently accounts for his Lordship's gradual, and even rapid, loss of strength, and for the fatal consequence,

The restoration of animal power and strength, by sleep, in our system, is indeed of such absolute indispensable necessity, that a long want of it, must terminate in madness or death.

That it did not terminate in the former calamity, must be matter of joy to all, who knew the virtues of this excellent man, as much as they must ever lament their loss and misfortune, by the latter event.

This sad case affords instruction and warning to the studious, the delicate, and the anxious breast.
Sleep,

Sleep, tired nature's sweet restorer, cannot be safely dispensed with. But the proper times and necessary duration of it, to each individual, depends much upon custom. Study, protracted far into the hours of night, cares harboured, and, even very late hours in company, by encroaching on the hours of sleep, are sure to bring on debility, with all its extensive consequences; and nervous irritability, with the innumerable dire diseases in its train.

They put the brain more or less in a state unapt for rest, in a state of uneasy vigilance: and a multitude of facts, in the ingenious tract of *Tissot* on the diseases of literary and sedentary persons, shew, that the aptitude of the brain, to restore by sleep, the impaired energies of the animal frame, may be lost altogether, and, fatal consequences, similar to what I have exemplified, and others equally melancholy, ensue.

Much it imports, therefore, the studious, to limit their learned labours to proper hours, to support strength by intervals of exercise in the open air, and, to all others to solicit sleep, by a seasonable and early dismissal of business and of care: and to compleat the instructions to be derived from this great example, to live virtuously, and to die with resignation.

The publication of this case seems to me proper, as I have had the honour to be referred to by an eminent writer, for an account of the last moments of Lord *Lyttelton*; and an extract from a letter, I wrote by his dying command, to an excellent lady, a luminary still brightning our horizon, was, by accident, published in the very prejudiced account that author has given of his Lordship. (See *Johnson's Lives of the Poets.*)

The following character, drawn for another nobleman, by the pen of *Erasmus*, is so perfectly applicable to that of Lord *Lyttelton*, that I yield to the impulse, I feel, to inscribe it, as a tribute of veneration to his memory. He was indeed, "Inter doctos nobilissimus: inter nobiles doctissimus, inter utroque optimus: ut enim antiquam generis claritatem eruditione. — Eruditionem, miro vitæ candore decoravit; sic his omnibus, omnium pulcherrimam apicem, et colophonem addidit, admirabilem animi modestiam!"

VIII.

Some Account of HEPATITIS SUPPURANS.

IT is certain, from observations of gentlemen who have published descriptions of the diseases of warm climates, that diseases of the liver are there very prevalent.

They are also often met with in this country, especially during hot seasons: this fact, which is, perhaps, not sufficiently impressed on the mind of every practitioner, will apologize for the following short account of a few remarkable cases of the Hepatic kind, which have lately come to my knowledge. [1789.]

The Hepatitis has been so well described by Boerhaave, and his excellent commentator, and others, that it is not my design to attempt a general

ral description of the causes, symptoms, and treatment of this malady.

A very free use of mercurial unction, has been much insisted upon, as a salutary practice in this disease, as it has occurred in the East Indies: and calomel, repeated in proper doses, has been found greatly to assist the efficacy of other deobstruent and antiphlogistic remedies proper in this disease, as it has occurred at home.

In the summer of 1787, four persons were, nearly at the same time, seized with an illness, which was fatal to three of them, and for some time created a suspicion of poison.

They had been all employed in cutting down timber, in a wood situated in a deep gully, near Shakenhurst, in the month of June, the weather being wet, and at the same time uncommonly hot.—They were all seized with a profuse evacuation of green bilious stools, except one.

They complained but little of pain in the right hypochondrium, had no icteric yellowness, and but little fever, till the near approach of death.

Three of these persons were committed to the care of Mr. Gomery, a diligent surgeon in Bewdley,

ley, in considerable practice, of whom one recovered: mercurial ointment was rubbed upon the abdomen of this person; and he took besides, decoction of bark and tartar. vitriol. this method, in itself highly proper, succeeded in this patient, whose attack was much milder, than that of his companions, because suppuration had not taken place.

On opening the bodies of the three who died, (as will appear from the narrative of the cases and dissections here added, with which I have been favoured by the gentlemen who attended,) the liver was found suppurated to a prodigious degree. In more than one, the matter had eroded the diaphragm, and made its way into the right side of the thorax.

This was remarkably the state of one of the bodies I inspected with Mr. Gomery; (see Case second;) in which the right lobe of the lungs, as well as the liver, was much eroded and consumed: and the quantity of purulent matter, collected from the liver and cavity of the thorax, seemed to me near half a gallon. The skin of this person had no appearance of jaundice, and his symptoms in the course of his illness, did not differ from those of the rest.

Mr.

Mr. *Seager*, an experienced surgeon of Bewdley, and coroner for the county of Salop, favoured me with the history of one of these unfortunate men committed to his care.

W. Stokes, aged forty, wood-cutter, July 7, 1787, applied to me: he complained of pain in his stomach and bowels, attended with diarrhœa.

These symptoms ceased, and I saw him again July 19; he then complained of pain in the right side, with slight fever, and a slow pulse: a blister applied to the side, removed the pain; but the fever remained.

July 23, he was seized with cough and sickness; this last was relieved by an emetic; but the cough continued till the 10th of August, when he expired.

He had no icteric symptom in the whole course of this illness.

On opening the body: — in dividing the cartilages from the ribs, to raise the sternum, two quarts of matter issued out from the liver, and as much more was found in the right side of the thorax: Mr. *Seager* did not recollect any appearance of erosion in the diaphragm, which, nevertheless, had

had most probably taken place. The pericardium contained a considerable quantity of lymph; the intestines looked as if they had been well injected, and were greatly inflated with wind.

Notwithstanding the alarm of poison, no evidence notified the suspicion: and it is sufficiently clear, the malady arose from their business and situation, exposed to a hot sun, and lying in wet cloaths; the ground covered with rotted leaves; and the taking in greedy draughts of water, and other cold liquors, in their heated state: the application for medical assistance was late, and probably not till after the state of suppuration had taken place in three of them: and 'twas dissection which discovered that, before unsuspected, state.

Bontius, in his account of the Hepatitis of the Indies, recommends an external opening by caustic, as the only remedy for the apostem, which follows inflammation of the liver; and it has often succeeded since his time.

Dr. *Fordyce*, (*Fragmenta Chirurg.*) was successful in curing an abscess of the liver, by an external opening: another case of that nature was treated in the same manner, but without success, and the patient died hectic. The abscess, originally in the liver, had eroded a passage into the thorax, as in the cases here related.

These

These abscesses form adhesions to the peritoneum, and sometimes make their way through the muscles of the abdomen; and are often cured by an external aperture, of which an instance occurred in our hospital, in the case of one *Macmaster*, in 1789, under my care.*

Bontius, in describing the causes of the obstruction and inflammation of the liver, occurring frequently in the Indies, ascribes them much to the abuse of arrack: "Dum enim ejus haustu, ebriofisti calefacti, ingentem aquæ copiam in ventriculum ingerunt, dein humi tanquam pecudes procumbunt, & in navibus se rori, qui post secundam aut tertiam noctis horam, copiose cadit, exponunt; inde Venenatos Vapores 'e terra erumpentes, intra corpus recipiunt, & sic obstructionem hepatis facillime incurrunt, cui adest tensiva, in hypochondrio dextro, gravitas, dolorque obtusus, & quasi pondere premens." &c.

The description of *Bontius* exactly agrees with what happened to the wood-cutters, and, in the following remarkable case.

I was called August 21, 1789, to a farmer near Leominster,

* See three cases of abscess of the liver terminating in empyema, p. 137 and 573 of third vol. of Med. Memoirs, London. And an account of Hepatitis in Dr. *Saunders's* learned treatise on the structure and diseases of the liver.

Leominster, of the age of forty years, and of a robust make. Three weeks before, he had been excessively fatigued in pitching up hay upon a rick. He was seized with pain in the bowels and stomach; after which a tumour gradually rose to a considerable size, in the region of the liver, stretching over and across the stomach, with great tension and sense of weight: a quick regular pulse, with much heat and thirst, but no yellowness of the skin, or bilious appearance in the urine: the uneasy weight of the tumour, though the pain, properly so called, was dull and inconsiderable, made him stoop forwards, and support his body on a table. The bulk was so large, as to force the diaphragm and heart very high up the thorax; for I felt the throbbings of the heart, near the sternum, betwixt the fourth and fifth ribs. He had four or five stools daily, which fermented like yeast.

Believing the disease to be a Hepatitis, verging to suppuration, and with little expectation of effecting a cure, I desired Mr. Geary, the able surgeon who attended him, to repeat venæ-section: and to rub, every other day, half a drachm of ung. merc. into the hypochondria, and to take the following medicines.

R. Tinct. theb. gutt. xv.

Oxymell. scillit. semi drachmam.

Vin. antimon. gutt. xx.

Julep. camphorat. unc. i. f. haustus sumendus
hora somni, alternis noctibus.

R

R. Cam-

R. Camphoræ pulv. Jacob. aa. scrup. fs.
 Pil. scillit. drach. i. f. pil. xviii. cap. pil. iii.
 bis vel ter die.

R. Decoct. pectoral. libr. fs.
 Tartar. vitriolat. drach. ii. sacch. alb. semun-
 ciam m. cap. coch. ii.—tertiis horis.

I enjoined the liberal use of cheefe whey, as his principal, or only drink, to which his great thirst disposed him to a ready obedience.

In a few days he had an immense discharge of a dark coloured, purulent matter, by stool, and the swelling gradually subsided.

Though the relief he had from this effort of nature, gave some hope, it was still apprehended, the suppuration which had taken place, would gradually consume him:—and I ordered the following medicines, with a fearful expectation of the event. A small dose of pulv. Doveri. at bed-time, and decoct. cort. Peruv. with tartar. vitriol. and myrrh, three or four doses daily.—I heard of his recovery, but did not give entire credit to the information, till I saw him a year after, in perfect health: in which state he has continued, as I am informed, to this time.

He

He has no fulness in the region of the liver, or any other remains of it, to be perceived, except some degree of hardness, which I thought I felt in that part.

This is one of those cases, in which the event was favourable beyond expectation. *Boerhaave* has an excellent and comprehensive section on the Hepatitis multiplex, in the Aphorisms; one of those productions which ought to be eternal, and which should be daily in the hands of physicians. Here, that great man points out the various channels, by which the purulent matter, formed in the Hepatitis, may be discharged. As the disease, in a slight degree, is, I believe, not uncommon, and yet is seldom suspected, from the slight dull pain, or total want of it, and the absence of jaundice, I hope these observations will have their use, in exciting the circumspective attention of practitioners in all cases, and in supporting their diligence and hope, in the worst cases.

When a disease, with some fever, is attended with a bilious colour in the urine and skin, and a fulness, with heavy pain, and uneasy sensation in the right hypochondrium, a disease in the liver will naturally be suspected: but such a disease often occurs without any such symptom, and then is only to be discovered by a nicer attention to a chain of

circumstances, which lead to the discovery of the part affected: such particularly are, a certain degree of hardness and fulness felt in the liver, accompanied with thirst, heat, anxiety and uneasiness about the stomach, with want of appetite, low fever, and such antecedent causes, as are known to occasion inflammatory diseases: besides, the experience and sagacity of a physician will, for the most part, direct him to a right judgment of the disease, and method of cure.

The memoirs of *M. Petit* the younger, and of *M. Morand*, in the *Memoires de l'Acad. de Chirurgie*. 2 tom. contain observations on the surgical management of abscesses of the liver, which deserve to be consulted.

The formation of pus in the liver, is sometimes very sudden, as in three of the wood-cutters, and in *Mason*, especially if the inflammation be acute, and the fever, its principal symptom, be considerable: nevertheless, it is formed often when the fever was not very considerable in the beginning: and sometimes, the formation and congestion of matter, is very slow.

The pains complained of in this disease, are seldom acute, unless the inflammation attacks the surface of the liver, the suspensory ligament, the peritoneum, and the diaphragm.

When

When the concave surface of the liver is concerned, the pains arise from the inflammation affecting the contiguous membranes, and nerves of the gall-bladder, the stomach, the duodenum, and the colon, which is often eroded by the pus, and by that way it makes its exit from the liver, and is discharged by stool.

The dull sensation of the liver in an inflammatory state, was observed by *Galen*, and the ancients; the observation has received repeated confirmation from the best authorities. — *M. Petit*, *M. Morand*, and *Dr. Heberden*, take notice of it. — *M. Morand*, ascribes the insensibility of the liver, in a morbid state, to its having but few nerves. The fact, however, is, that the liver has a considerable supply of nerves; and the insensibility observed in it, in common with the pancreas, spleen, and other parts supplied with nerves, from the great sympathetic nerves, arises from the ganglions, whence results the obscure and indeterminate sensation of all the viscera in the abdomen.

Abscesses in the upper and convex surface of the liver, which are probably the most frequent, erode often passages through the diaphragm into the thorax.

M. Petit, records the case of a patient so affected,

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by

by *M. Taillard*, in which the matter pointed outwardly, and a fluctuation directed to the performance of the operation for the empyema, by which a very great quantity of matter was voided; and in passing the finger into the breast, he felt the hole in the diaphragm, which went into the convexity of the liver, the original seat of the abscess. The patient was cured, and the wound healed in six weeks.

Another encouraging circumstance worthy to be noted, is, that though the waste of the substance of the liver, by the formation of such prodigiously large collections of matter, be great, yet when the matter is evacuated, the healing and regeneration of the consumed substance, is very speedy.

In a patient labouring under an abscess of the liver, who died, *M. Pibrac* found the abscess contiguous to the colon, which was eroded by the matter; and it appeared in the stools of the patient some time before death. This patient had not strength to support her under the discharge, and, to enable her to receive the advantage, of this effort of nature, which seems the only resource in abscesses thus situated.

In the valuable collection of observations, of the late *Dr. Stork*, the following is recorded, p. 8.—

A man,

A man, aged thirty-four years, during a bloody flux, had also a tumour in the right hypochondrium.—The bloody flux stopped in three months, and in two more, the tumour broke outwardly, and discharged a pint of thick reddish matter.—After this, the purging returned, and he died in seven months from the first attack.

The edge of the right lobe of the liver, and the neighbouring part of the transverse arch of the colon, were found adhering to one another, and all of them ulcerated. The colon was at that part perforated by small apertures, and its internal coat near the apertures, irregularly eroded. *Stork's* works, 4to. p. 8.

An adhesion is ever essential to the happy and fortuitous efforts of nature.—Messrs. *Morand*, *Petit*, and others, compare the appearance of the matter, to that of the lees of claret. *Mason's* was of this colour. He was relieved, probably, by an erosion of the colon, similar to Obs. iv. in the Memoire of *M. Petit*.

Abscesses, most likely to be relieved by operation, are such as point outwardly, and in which a fluctuation is felt in the epigastrium, beyond the margins of the cartilages of the ribs. That was the situation of the abscess, in the four patients

cured by *M. Morand*, whose method of operation and dressing, in such cases, deserves the attention of surgeons and physicians.

I now close these observations, by adding *Mr. Gomery's* account of two cases of the unfortunate wood-cutters, one of them not before described; and I have only to remark, that the adhesion of the inflamed part, and of the abscess which follows, is always necessary to prevent the effusion of matter into the cavity of the abdomen, and is the only natural circumstance, by which art or nature can effect a happy termination of the disease.

IX.

*Two Cases of SUPPURATED LIVER, communicated by
Mr. Robert Gomery, surgeon, in Bewdley.*

1. **B**ENJAMIN DALLER, ætat. forty, of a spare, thin habit, was attacked on Monday, the 25th of June, 1787, with a diarrhœa, and griping pain in his bowels, which continued, without any other complaint, except some loss of appetite, and debility, about a week;—his stools were dark coloured, and sometimes streaked with blood:—he then complained of pain in the right hypochondrium, which was acute upon deep inspiration, or motion, and attended with some difficulty of breathing: the diarrhœa still continued. On the 12th of July, the pain and dyspnea were very considerable; his pulse rather quick, and very small: he had some thirst, though his tongue was clear and moist, and his skin not particularly hot; the

the purging still troublesome, his stools slimy, but not dark coloured. A short dry cough came on some days after, with increase of pain, and difficulty of breathing, particularly upon lying down; and a sense of fulness, and soreness, in the region of the liver: his pulse became rather quicker, but was still very small, and his skin not hot:—he complained of head-ache, and his sleep was much disturbed;—his urine rather high coloured, made in small quantities, and with pain; appetite very indifferent. He was now much emaciated and weakened—the diarrhoea somewhat abated.—

On the 17th, the pain and soreness were very great, with considerable fulness in the region of the liver; the cough and dyspnea so much increased, as to render his lying down almost impracticable.—He now complained of a pain in his right shoulder, and his legs were much swelled: the secretion of urine small, voided with pain, and high coloured. His eyes and countenance had a yellowish cast:—his pulse very small and weak, rather quick; but his skin little hotter than natural: scarce any thirst, but total loss of appetite.—His cough was attended with very little expectoration. In a short time he was unable to lie down, but obliged to rest with his head inclined forward upon a pillow: his stools, which were now less frequent, became pale coloured; pulse extremely weak; his legs cold, and very much swelled. In this state he languished till the 24th, when he died suddenly, without a groan.

Appearances

Appearances on Dissection.

The liver appeared much enlarged, and very dark coloured on the lower part; the gall-bladder much distended with bile. A quantity of coagulable lymph lay upon the lower part of the convex surface of the right lobe, by which it slightly adhered to the peritoneum; higher up, under the diaphragm, it adhered very much, and upon being separated, a large quantity of thin curdly matter, of a brownish colour, gushed out: upon further examination, several large abscesses were found, some of which had made their way through the surface, but the matter was confined by the adhesions surrounding the openings; they nearly occupied the whole of the right lobe: the quantity of matter taken out was full three pints: — there was no adhesion of the left lobe, nor appearance of inflammation on the surface, but upon cutting into it, a quantity of matter was found in the centre. — The omentum was of a brownish colour, the vessels in it very full, and on the lower part of the right side, some coagulable lymph was found, but no adhesion. — The spleen appeared sound, but rather larger than common. — The stomach appeared, outwardly, without any marks of disease; in the inside, some parts were of a deep red colour, particularly the posterior part of the great curvature; it was also spotted with the same colour in different places. — The pylorus was in its natural state,

state, as well as the duodenum, except the latter having rather a greenish cast; but the jejunum, and ilium, were of a dark brown colour, and in some places greenish: the internal villous coat of the ilium, was very dark coloured, and some coagulable lymph lay upon the outer surface. — The colon was of a greenish colour, particularly on the right side; towards the sigmoid flexure, it became more of a natural colour. — The mesentery seemed to have been generally inflamed: — the kidneys and bladder perfectly found. — In the thorax, the lower part of the right lobe of the lungs, adhered very strongly to the diaphragm, and appeared to have been much inflamed: — the left lobe was found, and without adhesion. A small quantity of bloody serum was found on both sides.

2. *Richard Clark*, ætat. thirty-eight, of a strong healthy habit, was attacked on Tuesday, the 25th of June, 1787, with a diarrhœa, and pain in his bowels; this continued for at least a week, without any other complaint. — He then complained of shooting pains in the right hypochondrium, extending across the stomach: he had also some difficulty of breathing. — The pain in his bowels continued, but the diarrhœa diminished: — stools dark coloured. A short time afterwards he was bled, which gave him some relief. — On the 18th of July, he complained of considerable pain, with a
sense

fense of fulness and foreness, in the region of the liver: his breathing difficult, with some cough: he had also some difficulty in voiding his urine, with foreness and stiffness about his loins: — diarrhoea continued, though not very violent. — In a few days the pain abated; but there was considerable fulness and hardness in the region of the liver, with great foreness: his cough became more troublesome; legs began to swell. — Dysury continued, with small secretion of urine, not very high coloured; but it became turbid, and settled upon standing. — His head was rather painful and giddy; sleep disturbed, and skin much hotter: he could lie down in bed, without much shortness of breath, except on his left side. — On the 23d, his fever was considerably encreased, he was very thirsty, and his tongue much furred. Cough and dyspnea became worse, with the fulness and foreness; the diarrhoea more troublesome; and he sweated very much in the night: pulse quick and weak, and his legs much swelled. Dysury continued. — Some days afterwards, he began to expectorate a brownish matter, of a bitter-sweet taste. — On the 28th, some blood was voided in his stool; his pulse was very quick, and his face much flushed: dyspnea considerable, particularly upon motion, or lying down; the pain in the hypochondrium encreased, extending up the thorax to the right shoulder, and was sometimes very acute; the foreness

foreness and fulness very great; the cough not so frequent, and but little expectoration; his tongue much furred and dry; sleep disturbed. — These symptoms continued nearly the same, but with great increase of debility, till the 3d of August, when he died.

Appearances on Dissection.

The right lobe of the liver adhered very much, on its convex surface, to the peritoneum; the left lobe was much enlarged, and covered all over with yellowish spots; there were some also on the under part of the right lobe: a large abscess was formed in the right lobe, occupying nearly the whole of it, which had ulcerated through the upper part of the convex surface; the opening was surrounded by adhesions to the diaphragm, through which the ulceration had continued into the under part of the right lobe of the lungs; this also was surrounded by adhesions. — A small abscess was formed in the concave surface of the left lobe; the inside was full of the same yellow spots observed on the convex surface. — The concave part of the right lobe, adhered much to the parts in contact, but was not ulcerated. — The omentum adhered considerably, both to the liver and peritoneum; — the colon was of a greenish colour: — the other intestines, and stomach, in their natural state. — In the thorax:

on

on the right side, a large quantity of water was found, mixed with matter of a brownish colour; this lobe of the lungs was covered with a crust of coagulable lymph, much collapsed, and adhered to the pleura, on the posterior part, as well as to the diaphragm: those parts of the pleura not adhering, were covered with a crust of coagulable lymph.—There was no fluid in the left cavity; and that lobe of the lungs perfectly found.—Some water was found in the pericardium; but the heart perfectly found.

X.

Two Cases, communicated in a letter to the late Dr. John Fothergill, London, by James Johnstone, March 20, 1758.—Published in Medical Observations and Inquiries, by a Society of Physicians in London.—Vol. ii. 1762.

Kidderminster, Feb. 25, 1758.

DEAR SIR,

AS I imagine the following cases may not be inconsistent with the judicious plan the Medical Society have laid down for the improvement of their art, if you think my manner of drawing them up not improper, I beg leave, by your means, to submit them to the disposal of the Society; to whose laudable endeavours, I heartily wish all encouragement and success. And am, with the greatest esteem and gratitude,

SIR,

Your much obliged,
and most humble Servant,

JAMES JOHNSTONE.

C A S E I.

Mr. B. W. of Bromsgrove, a person of a habit of body, rather inclined to leanness, of a grave and thoughtful disposition, and about sixty years of age, had enjoyed a good state of health: in his youth he had been laborious; of late years less so, though still active; but at all times sober, and regular in diet.

On the 23d of January, 1756, I was sent for, and attended him. For a quarter of a year, and upwards, he had complained of want of appetite, with a weight, and obtuse pain, about the lower orifice of the stomach: these complaints were still rather increasing, with great depression of spirits, paleness, and bodily weakness. His pain, though never very acute, was sometimes more severe than usual, and might be considerably increased at any time, by pressing upon the right *hypochondrium*, near the pit of the stomach. He complained also of acid, disagreeable, bitter, and nauseous belchings, for which his apothecary had given him a vomit, but without relieving him. His pulse, in general regular and slow, sometimes gave a few quicker strokes, with some hardness. His urine was not pale, and was voided in small quantities: his feet were cold; his skin dry. He took, by my directions, several medicines of the ant-acid,

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bitter,

bitter, balsamic, and chalybeate kinds, with aloe-tics, and soap: from these he seemed at first to gain some relief, but that was very inconsiderable, and not lasting; for soon after, he was observed to become manifestly paler, weaker, and more emaciated. He then consulted another physician, who, as I understood, had ordered him medicines of the same nature with those he had taken by my directions, and with no better effect. He every day languished more and more; at last became so weak, as to faint away upon the least motion. About four months after I had been at first concerned for him, I was again called, and found his strength and flesh wasted exceedingly; yet he had undergone no considerable evacuation: he still continued so costive, that no stools could be procured without glysters: he had no sweats; his urine was in proper quantity, and of a natural colour; he had slept all along tolerably well: he was pale to the last degree; sometimes with a slight yellowness, which was not permanent: his pulse was very slow; the pain at his stomach was now, in a great measure, gone; but his want of appetite, and nauseous disgust to food, rather had increased. I ordered him to use only asses milk, with a little *magnesia alba*, and nourishing broths and jellies: by these his strength was somewhat recruited, so that he could get out a little way in a chaise; and sometimes his better spirits flattered him with hopes
of

of recovery, but in vain! His loathing, and want of appetite, grew worse; and his costiveness more obstinate. In the beginning of August, 1756, he began first to complain of cholic pains in his bowels, from which he was a little relieved by emollient glysters. About the middle of the month, he felt a sharp pain at his stomach, and vomited up a great quantity of a chocolate coloured, turbid fluid, and died immediately.

He had taken nothing for a considerable time, which could be supposed to occasion that turbid brown colour in the fluid he vomited up. All medicines, and most solid foods, from the beginning of his disorder, to his death, caused more or less of a disagreeable sickness, and belching, for a long time after; but milk, broths, and soft liquids, agreed tolerably well with him, to the last.

August 20. His body, which was extremely emaciated, was opened by Mr. Cooper, surgeon; two more of his profession, and myself, being present, with several other intelligent spectators. And the morbid appearances observed were the following:

1. After Mr. Cooper had laid open the *abdomen*, we perceived the stomach uncommonly large, and extended far beyond its usual limits, for it covered

all the superior part of the *abdomen*, from the *cartilago xiphoides*, to the navel, and its whole breadth from left to right: the *omentum* covered the remaining part of the *abdomen*, down to the *ossa pubis*.

2. Upon raising the liver, we perceived the right orifice of the stomach drawn along with it, and connected to it, by a preternatural and strong adhesion, tying the great lobe of the liver, to the curve of the stomach near the *pylorus*: upon applying the knife to this adhesion, it was found tough, hard, and white: in cutting it from the liver, we discovered an abscess contiguous to the liver and this ligament, containing some thick whitish yellow matter, like cream. In the same lobe, a little below this abscess, we observed a livid protuberance, of the ordinary size of a coat button; this being cut into, was found of a spongy texture, and contained some bloody water; the liver near this, was neither firm, nor very well coloured. The rest of the liver was firm and sound, but, as well as the gall-bladder, was somewhat larger than usual.

3. The stomach, all about the *pylorus*, (whence the adhesion, No. 2, was extended to the liver,) had its coats and substance very much thickened with scirrhus knots, at least an inch thick, which made

made the external and internal surface of the adjacent part of the stomach, appear unequal and knotty; the internal surface, at this place, being squeezed, yielded a thick, slimy, and chalky coloured stuff, of a most fetid smell. These scirrhus knots went round the whole circle of that part of the stomach, and yet had not entirely closed up the passage, which remained tolerably open for liquors both to pass from the stomach into the *duodenum*, and for bile to regurgitate from the *duodenum* into the stomach.

4. The stomach contained near two quarts of a coffee coloured liquid, like nothing he had taken, but perfectly resembling that which he had thrown up just before his death. It exceeded very much the quantity of any liquid given him for some time. The surface of the internal coat of the stomach was, in some places, discoloured with crimson and livid spots, of the breadth of a sixpence.

5. The cellular mesenteric membrane, which involves the beginning of the *duodenum* and the *colon* under the liver, was remarkably inflamed and coloured with blood. The end of the *pancreas*, next the *duodenum*, was very scirrhus. The *duodenum* contained much viscid bile, of a dark brown colour. The small guts were in various places distinguished with livid spots. The great guts, (by

his long difuse of solid food, and the small quantity of *feces*, were reduced to the size of the small guts.

6. The kidneys were large, but not unbound. The lungs of the left side adhered to the *pleura*, otherwise were perfectly sound; as were likewise the heart and spleen. The great cavities of the breast and *abdomen* contained no water, except the usual quantity in the *pericardium*. His body inwardly, as well as outwardly, was reduced to the last degree of leanness.

Upon the whole it is observable, that this disorder, at first beginning with the appearances only of a common stomachic complaint, turned out a fatal Cardialgia Chronica, from the the scirrhus state of the parts about the *pylorus*; and from putrescence there, as well as from the abscesses in the liver. But a gangrenous seizure of the coats of the stomach and intestines, appears, by the last symptoms complained of by our patient, and by the morbid appearances, (No. 4, 5,) to have been the more immediate cause of his death.*

Few persons from mere flatulency, acid eructations, want of appetite, and slight inconstant pain at

* A few similar cases have since occurred to me in the course of practice: they are generally unfortunate. The disease is carefully described by *Dr Haen*, Ratio Med. 6 part.

at the stomach, would dread much danger: but as this history shows us, that insuperable causes, besides spasm, relaxation, or foulness, sometimes occasion no other than these familiar symptoms, the greater ought our care and attention to be, in examining into the nature of diseases, before we rashly promise to ourselves, or our patient, a cure, which it may not be in our power to perform.

C A S E II.

Opportunities of examining the bodies of persons dying in the paroxysm of an epilepsy, are not very frequent; yet from such bodies it seems not unlikely that some light may be derived, to advance our knowledge of this disorder, which, like many other diseases of the brain and nerves, is not perfectly understood. In the summer of 1754, an accident, which had befallen the son of one *Harrison*, in this place, a youth of about ten years of age, and the father's uncommon desire of knowing the cause of his son's disease, gave me such an opportunity.

The boy had been greatly troubled with epileptic fits, ever since he was two years old; and as they came on him without any external or known cause, they could be removed by none of the remedies which had been tried for his recovery. He

had been blooded at least three times; and his fits were, as the father told me, remarkably, more severe and frequent after these evacuations. He observed no other forerunner of the paroxysm, besides a pain in the *abdomen*; after which, the boy was used to fall down convulsed, and remain perfectly void of all sensation, till the paroxysm was ended; after which, he would sometimes doze a little; at other times, he would immediately be brisk and lively, and play, or eat, as if nothing had been the matter with him. These fits had grown gradually more frequent; he hardly was ever free from them twenty-four hours: some days he was seized with several fits; and he had four fits the morning he died. In the last of these fits, it was supposed he had fallen down in a prone posture, with his face sunk a little into the mud of the common sewer: in this situation he lay unobserved, till he was perfectly suffocated,

His body and limbs were firm and plump; his hair brown. We found his hands as high as the wrists, and his feet up to the ankles, of an intensely livid colour. His face, and every other external part of his body, excepting the hands and feet, were pale, as usual in dead bodies.

Having opened the *abdomen*, the contents thereof seemed sound; only his stomach and bowels were rather,

rather of a higher red colour than is usual, yet not inflamed. No worms were found in flitting up the intestinal tube, nor could I learn that he had voided any.

In his breast, we observed his lungs of their natural colour, spongy, and neither stuffed with blood, water, or *pus*. We were surprized to find much less blood than is usual, in the trunks of the *cava ascendens* and *descendens*, and in the right auricle and ventricle of the heart; and much more than is usual, in the left ventricle of the heart, and in the *aorta*. For here, where there is commonly little or none, we found nearly as much as in the right ventricle and *cava*.

The futures of the *cranium* were close, and much less visible than is usual at the age of ten years. The longitudinal and lateral *sinuses* of the brain, were almost quite empty of blood. The vessels, ramified upon the surface of the brain and *pia mater*, were prodigiously fuller, and more distended with blood, than I had before observed in any other dissection: and the drops of blood, which came out in great numbers upon cutting into the substance of the brain, were also larger than usual. An ounce and a half of water was found in the ventricles of the brain; and a small hydatide, like a pistol bullet, adhered to the *plexus choroides*:

chorooides: the vessels of this part were likewise much distended with blood.

These were the only morbid *phænomena*, which were taken notice of in this body; and as these seem to afford some useful inferences, I beg leave to propose the following.

In the whole narrative, nothing is more remarkable, than the fulness of the arteries, which, in most dead subjects, are generally found empty of blood, and pale, and contracted. This fulness of the arteries seems to have extended to their smallest ramifications; not only in the extremities, which were livid, but also in the substance of the brain itself, the small vessels were observed very full of red blood; and it is most probable, that these vessels were not veins, but arteries; seeing the large *sinuses* of the brain were entirely empty: and *ut majora ita minora vasa*, seems a maxim which may, in the present case, be depended upon. It is some years since I was informed, by my learned friend Dr. *Short*, that he had known hæmorrhages produced from the surface of the body, by the confinement of the blood in the arteries: and, which is more extraordinary, the left ventricle of the heart burst, and the blood poured into the *pericardium* and *thorax*, from the violence of the epileptic paroxysm. In a word, this fulness seems to be the
real

real state of the arteries in the epileptic fit, whether arising from the pressure of the convulsed muscles, or, which is most likely, proceeding from an universal spasm, or constriction of the *arteriola minima*. And this effect proceeding as a consequence from the same primary unknown alteration in the brain, and its productions the nerves, which occasions the epileptic convulsions, will enable us not only to explain symptoms, but, which is more essential, will serve for a guide, by which our practice may be regulated, especially during the violence of the paroxysm. And surely, if any evacuation of blood be requisite, venæsection ought not to take place. The confinement of blood in the arteries, requires arteriotomy, or cupping, with scarification. Frictions, and above all, proper antispasmodics, both externally and internally.

XI.

*Cases of HYDROPHOBIA. Communicated by James Johnstone, M. D. C. M. S. S. R. M. Ed. S. Physician to the General Infirmary of Worcester; Member of the Philosophical and Literary Society of Manchester. With Reflections on the Prevention and Treatment of persons bitten by mad and hydrophobic animals.**

*Read November 21, 1785,
To the Medical Society, London.*

CASE I.

GEORGE POLLOCK, aged forty-five years, by trade a blacksmith, was admitted the 5th of March, 1750, a patient of the Royal Infirmary, at Edinburgh: about the end of November, he had

* See Med. Memoirs, vol. i.

had been bit by a mad dog, on each side his left leg, a little above the ankle; the wounds bled freely, and were washed with common spirits immediately: the next day he was bled, and bathed the sores in salt water, and, in about thirty hours after the accident, put himself under the care of Dr. Dundas, at that time a physician of considerable practice, in Edinburgh, who ordered sixteen ounces of blood to be taken from the arm, and the following bolus, two of which were taken each of the two succeeding days, without producing any very sensible effect.

R. Cinnab. nativ. Cinn. factit. aa. gr. xxiv.

Mosch. gr. xv. fyr. sacch. q. s. f. bolus.

He was then ordered to take a drachm and half of the *pulvis antilyssus*, every morning, in a little milk, for four mornings, to use the cold bath forty days successively, and to dress the sores with mercurial ointment.

He omitted, however, the cold bath the last eight days; and latterly, the ulcers were dressed with *unguentum basilicon*, instead of *unguentum mercuriale*: by these means the sores were kept open for a month, or upwards: he had no pain from them; but the matter discharged was always thin, and sanious, and at no time good *pus*. However, he.

he made no complaint till the 3d of March, in the afternoon of which day, he felt a pain and weakness about the loins, *os sacrum*, thighs, and false ribs, attended with heat, and sharp pain in making water; next day he complained of sharp pain in the abdomen, and about eight o'clock in the morning, began to have that aversion and difficulty in swallowing liquids, which afterwards increased extremely; so that when admitted into the hospital, he could not attempt to drink any thing, without a most dreadful effort: the attempt always occasioning his fetching deep sighs, and being affected with an universal horror, and such violent spasms in the organs of deglutition, as almost endangered his being choaked; yet, at no other time did he complain of any pain about his throat, or of heat there, and swallowed bread, and solid food, without any difficulty; his other pains grew every hour more severe, and they are increased constantly when he endeavours to drink: he said he would willingly drink, did not something, which he cannot describe, render the thought and sight of liquids disagreeable; and an attempt to take, and swallow them, an insuperable difficulty, and a violence which he cannot account for. He has not slept for forty-eight hours; his tongue is white and dry; his urine small in quantity, but high coloured; regular in stools; his pulse feverish and hard, and not much altered by his attempts to swallow liquids.

Dr.

Dr. *Rutherford*, professor of medicine, and, at the time, clinical lecturer, being much attached to the doctrines of *Boerhaave*, determined to try the antiphlogistic method in this case, and ordered the patient, who had been bled in the morning, to lose gradually, the large quantity of sixty-six ounces more: from this evacuation he became sick, and a little faint, and his pulse somewhat smaller and slower; though by no means in proportion to the quantity of blood he had lost. The blood was not fizy, but abounded with serum; the *crassamentum*, of a florid, scarlet colour, and its texture loose, like the blood of hysteric women. The Doctor also ordered his head to be shaved, and often embrocated with equal parts of vinegar and water; and a slice of lemon, with sugar upon it, often to be given him. Also,

R. Rad. Gramin. unc. ii. fruct. tamarind. unc. i.
coque ex Aq. font. lb. iii. ad lb. ii. sub finem
addendo.

Rad. liquorit, unc. fs. Colaturæ cap. unc. ii. omni
femi hora.

R. Sal. nitri pulv. drach. ii. Divide in doses vi.
cap. unam omni bihorio in haustu decocti.

R. Decoct. commun. lb. i. Mellis, unc. i. Sal.
nitri, drach. ii. m. pro enemate omni quarta
hora injiciendo.

He

He was ordered panada for his food.

Eight o'clock at night. The glyster brought away indurated *faeces*, in fifteen minutes after it was injected. Has taken four doses of the decoction, and some panada. His urine high coloured, drops some sediment; the pulse beats about ninety-eight strokes in a minute; his pains, and heat in making water, are lessened, but his aversion and horror to liquids are undiminished.

The Professor ordered the medicines already prescribed to be continued, and to take, after bathing his feet, the following draught.

R. Syr. diacodii, unc. i. repetendam intra spatium trium horarum, si opus fit.

R. Spir. vitriol. dulc. unc. fs. cap. gutt. xxx. sæpius cum potu communi.

Tuesday, March 6, at six o'clock in the morning. Last night, about nine o'clock, the injection was thrown in, and his feet afterwards bathed, from which a clammy sweat followed: for, the noise of the water, made by his feet, made him shiver, sigh often, and look wild about him. His pulse, at the time, beat 115 strokes in a minute, with an unusual tremor in it. His urine, made in the

the night, paler: he had two clysters, and two anodyne draughts, after which he slept two hours at different times; being pretty free from pain, unless when urged to drink, at which time, pains in the belly, beginning at the pit of the stomach, came on, and were attended with frequent shivings, and violent convulsions. Directions were punctually observed. In giving drink, it was remarkable, that he always took a second or third draught, with less reluctance than the first, and, therefore, two or three draughts were commonly given him successively.

Eleven o'clock. The *pediluvium* produced an hour's sleep, and his pulse rose: his pain in making water gone, but *Hydrophobia* increased: he cannot take any liquid, and has an extreme aversion to any thing which looks like a fluid, or in which any fluid has been contained; but, when his eyes are shut, or covered, he can still drink.

Seven o'clock at night. He complains of a stounding pain, as he calls it, in his belly and small of his back; which is most acute on moving, or sitting up, in his bed. When he drinks, which he never does without horror and convulsion, he feels a stinging pain in his stomach, but none in his mouth or throat. Immediately after drinking, he sweats about his head and breast, with vehe-

ment efforts to vomit, though nothing comes up. His pulse hard, beats 104 strokes in a minute; his tongue white and foul, fauces red, urine pale: he had a clyster, which operated twice, but brought away nothing but slime; his hands cold.

Ten o'clock at night. He goes on as before directed; attempts to drink with the same reluctance, horror, and convulsive motions, with deep sighings; and after these, retchings, vomiting, increased quickness of pulse, and return of pain. He spits *saliva* with great quickness, and with aversion. If it falls on his hand, he, as quickly, wipes it off, yet does not complain that it tastes amiss. He never offers to spit upon, or molest any one. He sometimes slumbers for a few minutes, but it is interrupted by deep sighs and convulsions. His pulse, after bathing, rose to 120 strokes in a minute; though it has continued generally at 100 strokes, with interruptions. He voided an ounce of turbid urine, and took panada with the usual reluctance, and a dose of fyr. de mecon. after which he slept half an hour.

Wednesday, March 7, eight o'clock in the morning. He was quite delirious betwixt six and seven, but is now pretty sensible. He makes strong efforts to drink, though now for the most part ineffectually.

Eleven

Eleven o'clock in the forenoon. These efforts to drink, always produce belchings, retchings to vomit, and pains, which begin in the lower region of his belly, and squeeze every thing upwards towards his stomach, attended with convulsions and deep drawn sighs. His eyes are dismally wild, red, and inflamed: talks much concerning his wife and family, with great affection; speaks in a religious strain, and says he is dying. Pulse quick, but very weak and intermitting. He has had two bolusses. R. Mosch. pulv. scrup. ss. Conf. Rosar. q. f. f. bolus. Continue them every hour, and, as he cannot swallow any thing liquid, let the clysters and embrocation be used the oftner. R. Sal. nitr. succhar. alb. aa. p. æ. redige in pulv. a little of this to be given frequently.

Four o'clock in the afternoon. He had a musk bolus about one o'clock, and opii. gr. ii. was offered, which he could not swallow. In spite of every effort to relieve him, the symptoms of death approach, with intermitting pulse, cold sweats, cold extremities; and in attempting to drink with his usual courage, he was violently convulsed, the liquor, as in one choaked, regurgitated back through his nostrils, he fetched a deep sigh, reclined his head, and expired. He never had been furious, or in the least inclined to offer violence or mischief to any one; on the contrary, he was

somewhat anxious lest he should be the occasion of it. A looking-glass was frequently held before him, but it never discomposed him in the least.

Next day his body was opened by Mr. G. *Lauder*, at that time a celebrated surgeon in Edinburgh. The stomach was much contracted in its ordinary size; and contained nothing. The small guts seemed sound, only the *ilium* seemed a little inflamed, and a few livid spots were seen upon it. The sac of the colon was near as large as an ordinary person's head, and, besides air, contained a large quantity of *fæces*. It was observed, that the intestines were much out of their usual situation and order. The liver appeared a little livid; the gall-bladder much distended with bile, which tinged very considerably the adjacent parts of the colon and *omentum*. Nothing unusual was observed in the contents of the thorax: and the further examination of the larynx and pharynx, and the opening of the *cranium*, were prevented, by the surgeon's finger being accidentally cut, which made it improper for him to proceed.

Dr. *Rutherford*, at that time professor of the practice of physic, and clinical lecturer, long celebrated as an able practitioner, as well as teacher of medicine, in Edinburgh, attended this patient, with the most anxious and humane care: and in
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the lecture which he gave on the case, he candidly retracted an opinion, which he had learned from *Boerhaave*, and which had directed the measures he took. he said, he was convinced now, that the *Hydrophobia* is a spasmodic, and not a high inflammatory disease. That, though bleeding may be useful, in preventing furiousness, neither that, nor the proper antiphlogistic method, are to be depended upon, as the proper cure of the *Hydrophobia*: that in such cases, after bleeding once or twice, he would order sal succini musk, and opium; and, perhaps, blisters. He thought bathing, and other prophylactics, should never be neglected; but professed no great confidence in the *Pulvis Antilyssus*, which had, about that time, been warmly recommended by Dr. *Mead*, but which, I believe, has since fallen into disuse.

This case may be found recorded in the books of the Royal Infirmary, at Edinburgh; but having been an attentive observer of the whole course of the illness, I have given it from my notes taken at the time.

Worcester, Oct. 24, 1785.

CASE II.

By Edward Johnstone, M.D. *Physician to the General-Hospital, in Birmingham, and Fellow of the Royal Society, at Edinburgh.*

AUGUST 16, 1784, I was sent for to Charles Bullock, of West-Bromwich, a fine lively boy, aged four years, of a strong vigorous habit of body. On Friday, the 9th of July, he was bit on the right cheek, and just under and above the right eye, by a mad dog. The wounds were small, bled little, and soon healed, leaving only a slight mark on the cheek, and a scar under the eye. The next day he began the use of the Ormskirk medicine, which he took in the manner directed in the paper given with it; and some of the powder, mixed with a little digestive, was applied to the wounds. He seemed to enjoy his usual health and spirits, till the 15th of August, except that about a fortnight* before that time, he was one afternoon very dull, and passed a restless night, but was as well as usual the next day. On the morning

* His father said at the full of the moon, though he did not appear to be certain of it.

morning of the 15th, he appeared very low and spiritless, had little appetite, his breath was observed to be very offensive, and he complained of a pain, shooting from the part where he had been bitten, to the teeth. He had a very restless night; and early in the morning of the 16th, Mr. *Beardmore*, an eminent surgeon and apothecary, was called to him, who immediately desired assistance.

I saw him about twelve o'clock, when he was walking about a room, in which a number of people were collected, with an appearance of great anxiety and horror, and a peculiarly fierce look; he started on my entering, and expressed great apprehensions of being sent to the salt waters; but was much composed and pleased, on my assuring him he should not go there. I then desired him to drink some small beer; he immediately turned away, changed colour, expressed the greatest horror and aversion, and was seized with a catching of his breath, and convulsive motions of the muscles about the throat;* but upon its being removed, soon recovered his usual composure, and, without difficulty, eat some bread and butter. A basin of water was afterwards brought in, without his perceiving it at first; but as soon as he cast his eye that way, he shewed great uneasiness, and upon

T 4

M. II. putting

* The same symptoms were likewise brought on, by his being exposed to a stream of air.

putting his hands into it, was immediately seized with universal tremor, and convulsive motions of the muscles about the throat, attended by a kind of fobbing, half respiration, and such an inexpressible anxiety, and gloomy horror of countenance, such a fierce scowling look of the eyes, as no language can give an adequate idea of, but which, if once seen, can never afterwards be mistaken.

The disorder being too clearly ascertained, I ordered him to be put into a warm bath, which was done suddenly; but universal convulsions immediately took place, attended with an appearance of suffocation, which lasted some seconds: his breathing gradually returned, with a noise similar to that uttered during each cough in the chincough, or in the croup, and he, at the same time, rejected a considerable quantity of viscid frothy matter. Being fully persuaded of the mischief of this practice, I directed a bolus, composed of tart. emetic. op. pur. aa. gr. fs. Mosch. gr. vi. to be given immediately, and to be repeated every hour; and the following injection to be administered every three hours.

R. Asafoetid. unc. fs. solve aq. pulleg. unc. vi.
 tinctur. thebaic. drach. ii. muc. gum. Arabic.
 unc. ii. M.

R. Miftur.

R. Mistur. præcedent. unc. ii. juscul. ovin.
unc. iv. M. Fiat. enema.

Unguent. mercur. fort. to be rubbed into the lower part of the face, near the wound, round the neck, and other parts of the body, as often, and in as large quantity, as possible.

In the evening he seemed much better, and on being asked to take some tea, with great resolution, though with difficulty, swallowed a spoonful, which immediately brought on the same symptoms as before. I saw him by six o'clock of the morning on the 17th; he had passed a very restless night, the recumbent posture always bringing on the paroxysms of the disorder. He had only taken two bolusses, but the glysters had been given regularly, and staid up; and a very considerable quantity of mercurial ointment, had been rubbed in. His pulse was much weaker than before, and very fluttering and variable. Upon endeavouring to walk, he reeled considerably, and was almost constantly endeavouring to spit out the frothy viscid *saliva*, which seemed very troublesome to him.* Upon being desired to eat some bread and butter, he took it into his mouth, but immediately spit it out,

* It is remarkable, that he was anxious lest the *saliva* should fall upon those about him, and frequently desired them to get out of his way, when he was going to spit.

out, and seemed to be in great agony. I directed four ounces of the mixture, with asafoetid. and tinct. thebaic. to be injected as before, and half a grain of crude opium, to be given him every half hour, if it could be got down; a blister to be applied to the nape of the neck, and mercurial ointment to be used as before. He only took two doses of the opium.

About eleven o'clock, he was seized with violent convulsions, particularly about the muscles of the throat, but affecting most of the other muscles of the body, during which, he snatched at those who were near him, and made a noise like a person suffocating: this fit lasted near half an hour; and afterwards, he was perfectly exhausted for some time, and fell into a cold clammy sweat. These convulsive fits, alternating with fainting ones, continued, with very short intervals, till four o'clock in the afternoon, when he expired.

Reflections on the Prevention and Treatment of Persons bitten by mad and hydrophobic Animals. By James Johnstone, M. D. &c. &c. &c.

1. **I** BEG leave to add some Reflections to these cases. The first case forms a kind of epoch in the treatment of the *Hydrophobia*, which is now universally acknowledged and treated as a convulsive disease, not without some hopes of success, if we may credit *Sanvage*, and other French writers of reputation; also the case treated successfully by Dr. *Nugent*; and one or two more, related in the Medical Transactions of the College, and in the Memoirs of the Medical Society of London.*

2. *Hydrophobia*, or an aversion and horror to liquids, is its true definition. A rabies, with a mischievous desire of biting, (see defin. *Linn.*) is, in man, I believe, seldom an usual, much less a constant symptom, in this disease. This aversion, or horror, is produced in the mind, by the action of the poison on the nerves, which occasions spasms in the throat, remarkably aggravated by every attempt to swallow liquids in particular, and accompanied

* Vol. iii. p. 454.

panied with various spasmodic pains about the *præcordia*; which are excited, and, in every part, increased, by the appearance, sound, and touch of any fluid. It is then a spasmodic *angina*; and the aversion to swallow may, in part, be an aversion to pain: but other *angina's* are painful, without this horror: I therefore conclude that, in the *Hydrophobia*, it partakes of delirium.

3. The attempting to conquer this aversion to the swallowing of liquids, produces dreadful, and, finally, fatal spasms: in the first instance, in the pharynx; perhaps from the salival liquors being peculiarly tainted with the poison: also the *œsophagus* and stomach, and all the parts in the abdomen furnished with nerves from the splanchnic nerves, and from that great centre of nervous sympathy and action, the great semi-lunar ganglion, called by some, *cerebrum abdominale*: which convulsions, in their continuance and progress, disturb the natural and vital functions, and, finally, arrest the motion of the heart.

4. During the *Hydrophobia*, the salival liquors, and those, perhaps, which lubricate the *œsophagus* and *primæ viæ*, being strongly impregnated with this fatal poison, may not the abhorrence of fluids, which characterises the disease, and which makes the swallowing of them so dreadful, be owing to the

the baneful stimulus of venomous *saliva*, on the nervous and irritable surface of the *fauces* and *primæ viæ*? And are not these spasms efforts, however ineffectual, of irritability, and the principle of life, to throw off this poison? It is certain, that antimony, and many vegetable poisons, are deleterious and fatal, as well as the poison of the viper and mad dog, though not discernible by taste.

5. Respecting the treatment of this poison, and such as are unfortunately likely to suffer by it, I apprehend the surest preventive is, (after wiping off, and washing it away as much as can be done,) to cut away, or scarify the bitten part immediately, and to destroy it by caustic, or actual cautery. (See here the method of *M. Le Roux*, Appendix.) This is to be done as early as possible, and beyond the depth and extent of the bite. If all this be done immediately, and no particle of the venomous *saliva* be left in the wound, the patient, by this operation, and by suppuration kept up for two months, by digestive ointments, armed with red *præcipitate*, will be in perfect security.*

At whatever time afterwards medical assistance is called for, the same local treatment is to be enjoined :

* The misfortune of *M. Rowley*, shews this external treatment, even when early performed, by a very able surgeon, does not give absolute security; and that other means of prevention deserve attention.

joined: and it is not to be omitted, even when symptoms of *Hydrophobia* are threatened, or appear; as the history of the disease shews, that the spasms which affect the throat, generally arise from the bitten part.

But this prophylaxis, though never to be neglected, cannot be supposed, and, in experience, has not been found, to give the same constant security, which it affords when done instantly after the bite. In such circumstances, the prophylactics which have been found most useful in preventing the progress and virulent effects of this poison, on the blood and nervous system, must be had recourse to.

6. Mercury has been found, in extensive experience, to be a very effectual preventive of *Hydrophobia*, and, in some instances, has assisted considerably in curing it: in the discreet application of this antidote, both externally and internally, and in adding thereto the antispasmodics and tonics, Peruvian bark, Valerian root, musk, and opium, the physician will probably give security to his patient, in most instances, if not in all.

The usual course which this poison takes, indicates the application of mercury to the bitten part, by applying it there, and by rubbing it around it; and

and also to the *fauces*, where it will mix with the *saliva* and *mucus* in the pharynx, *oesophagus*, and *prima via*, and obviate the tendency of the poison, in its most destructive course and period.

But the quantity of these mercurial administrations, must never be so great, as to excite a copious salivation, or considerably weaken or disturb the body.

In an adult, half a drachm of strong ointment, charged with camphire, should be applied to, and rubbed near the wound, daily.

And two grains of calomel ought to be rubbed every evening within the mouth, enjoining the patient to swallow his spittle for some time afterwards: in this way, it will mix with the *saliva*, and pass through the whole course of *prima via*; and, while it keeps the body open, will, in a small quantity, mix with the lymph and blood; and without disturbance or loss of strength, will meet and correct the poison, if it enters the habit.

In very young patients, and delicate ones, the quantity may be diminished; or, in stronger ones, increased.

After a fortnight, the calomel should be intermitted,

mitted, and a cathartic given, and an opiate in the evening, after the cathartic.

In ten days time, the calomel should be resumed for another fortnight, followed with a purge and opiate, and intermitted once more for ten or twelve days, after which it may be again used a fortnight, in the same manner, and then, if no symptoms appear, the use of mercury may be laid aside, and the patient's safety presumed upon.

If the patient's rest be disturbed, or any dejection, hurry, or melancholy appears, he ought to use, while this course is going on, musk, opium, asafoetida, and a drachm of an electuary of P. cort. Peruv. Valerian. aa p. æ. twice in the day, as occasion requires.

If any tendency to *Hydrophobia* appears, the dose of calomel, or quantity of mercurial unction, should be continued, and greatly increased: and a salivation raised as expeditiously as possible, by a cinna-bar fumigation.

Emetics of turbith mineral, have been found of great use in preventing *Hydrophobia*, and certainly ought to be repeatedly given, with opiates afterwards, to allay the hurry of nerves, if any of the forerunning symptoms of *Hydrophobia* appear.

Emetics,

Emetics, even of milder operation, as well as the turbith, must be highly useful, by evacuating the *saliva* and slime, if at all tainted, from the throat and stomach.

Hurry of nerves, arising from the remedies or the disease, require great attention; and must be removed by musk and opium. To dispel anxious fear, and to support hope and chearfulness, are indispenibly necessary in preventing *Hydrophobia*.

These are the means of prevention and cure I shall pursue when occasions offer; they will not always succeed, but I know no better; and none so much supported by experience and authority, or so closely connected with the real phænomena of the disease. In every disease, the best founded methods are sometimes unsuccessful: but to this, above all others, the introductory aphorism of *Hippocrates*, has the justest application: — *Occasio Præeeps*, &c.

APPENDIX.

I PROPOSE to give here, a short view of the methods recommended in the ingenious papers published in the second part of the History and Memoirs of the Royal Society of Medicine, at Paris, 1783, on the subject of canine madness.

The following is the method recommended by *M. Le Roux*. Having discovered the direction and full dimensions of the part bitten, by the mad animal, the wound must be dilated with a bistory round its whole circumference, and a cross, star-like, to make the surface larger than the bottom of the wound. The tendons, and larger vessels, are to be avoided as much as possible, in making these incisions. The wound is to be allowed to bleed freely, and to be washed with soap-water, or, the part is to be dipped in a bath of it, and then to be dried with lint, and covered till the next day. After removing the first dressing, a skewer of wood, dipped in deliquescent butter of antimony, is to be made to touch every part of the wound, particularly the bottoms and edges thereof, and
even

even the surrounding skin. Every part touched with this caustic, becomes immediately white, and burnt to a greater depth, even of some lines. A blistering plaster is then applied over the wound, and widely beyond it, and this finishes the second dressing. *M. Le Roux*, does not apply the liquid butter of antimony the first dressing, because the blood would dilute and præcipitate the caustic, into a kind of powder of algaroth, which is not caustic. He prefers the potential caustic, to the actual cautery, because it gives less terror and pain, and burns more precisely to the desired depth, and the escars are sooner separated. He has only twice met with wounds in parts dangerous to be burnt; yet he repented afterwards his tenderness, as both the patients died of Hydrophobia: when so serious a malady is to be feared, sacrifices must be made, and he will not avoid them in future. The blisters are cut and dressed the next day, and fresh butter applied to the wound, till the eschar falls off, which happens in a week: after this, the wound is kept open in abundant suppuration, by putting in several peas, or gentian root, of a size proportioned to that of the wound. As the flesh springs up, it is to be burnt again with the butter of antimony, and fresh blisters are again and again applied; for the wound must not be allowed to heal till after forty days. By this method alone, he secures his patients, and gives no other

internal remedy, except a few drops of spir. vol. alcalin. and not that always.

M. Baudot is persuaded, that the effects of the bite, however extensive they may become, proceed from the action of the poison on the part originally bitten only. After cleansing and washing the part with salt water, he applies a blistering plaster, which covers the wound, and extends considerably beyond it: he afterwards rubs mercurial ointment, with the addition of camphor, very plentifully all around the bitten part, and over it; to these he adds bathings, and frictions with warm oil: this treatment is continued fifteen or twenty days, by which means only, he believes the mercury destroys the *virus* fixed on the nerves in the wounded part, and, that the oil, in relaxing these parts, assists in hindering the ulterior propagation of those spasms, which would otherwise have extended their action to the salivary glands, and have excited *Hydrophobia*. A very great number of attested cases are produced, in support of the efficacy of this preventive method. If he be called to such as have not been early treated in this manner, and who are threatened by symptoms of *Hydrophobia*, he orders scarifications, in addition to the former method, with bleeding, nitre in apozems, opium, and other antispasmodics. His success was very considerable in every stage of the disease, the actual

tual *Hydrophobia* excepted, which proved always irresistibly fatal.

M. Bouteille, in a very methodical and well-written essay, agrees nearly in approving the same mild local treatment as *M. Baudot*, by ablutions and blisters; yet recommends also scarifications and cauter, when strictly necessary. He is also high in the commendation of mercurial ointment, rubbed daily near the wound, and applied to it; which, in his opinion, both draws out the poison from the wound, and corrects it, (61,) and, at the same time, eases the spasmodic pains arising from the virulence of the poison: but thinks a mercurial salivation, both ineffectual and pernicious. If the wound be cicatrized, when symptoms of *Hydrophobia* appear, he, in that emergency, recommends the application of caustic, or actual cauter, to the part, to open an external passage to the poison, which he presumes to be still acting there.

The mercurial method of preventing *Hydrophobia*, which had been censured as uncertain, and, in some cases, hurtful, by *M. Le Roux*, is very warmly adopted and recommended by Mess. *Baudot* and *Bouteille*, though on different principles; and so as to shun exciting salivation, which had been a mode in France, after *M. Sauvage* had published his ingenious *Dissertation sur la Rage*.

This mercurial method is the only one depended upon and recommended, in the Memoir of *M. Bonel*, de la Blagereffe, who trusts entirely to mercurial frictions, and to laxative mercurial pills, to be continued for about three weeks; and occasionally to be purged off by an increased dose of the pills, so that salivation may be obviated: he applies to the wound mercurial ointment only. He treated five hundred patients in this method, without a single miscarriage; and believes the same medicines, in double or triple doses, with the addition of musk, and other antispasmodics, to be an effectual cure in the *Hydrophobia* itself: of which he has no history to produce, as he had constantly succeeded by his preventive method.

M. Mathieu, maitre en Chirurgie, in Perigorde, after bleeding and purging, depends altogether on copious mercurial frictions, to excite salivation, unless the mercury occasions some other evacuation, which will supply its place. He says, the *Hydrophobia* yields, as it were, by enchantment, when the salivation appears; and it must be kept up, more or less, according to the degree of the disease, and strength of the patient.

Many instances have been produced in the course of these Memoirs, in which individuals were seized with, and carried off by, *Hydrophobia*, notwithstanding

ing mercury had been very early and amply used, even to salivation: be it so; but this does not invalidate other respectable testimonies, that in a prodigious number of instances *Hydrophobia* had been prevented, and in others, cured by it. Hear the respectable *Sauvage*, who concludes a masterly work in the following words: "Après bien de
" recherches, l'ignore que ce remède ait encore
" manque, étant, même appliqué quand la Rage
" étoit déclarée." How few infallible remedies can we boast of in other diseases! Shall we then quit this single anchor, because it has failed, as others have done before, though it is granted to have succeeded sometimes?

D. Metzlar, a German physician, in a very elegant and learned Latin dissertation, the last published in this volume, on the prevention and cure of *Hydrophobia*, concludes thus: "Haud aliud in
" terribili hoc morbo, habetur remedium quam
" mediante ferro instituta Inustio."

To this opinion, the Royal Society of Medicine seem indirectly to have added their respectable authority, by crowning the Memoir of *M. Le Roux*, with their first prize; their second being shared betwixt Mess. *Baudot* and *Bouteille*, for their ingenious Memoirs, and by their positive declaration, that the external treatment, which consists in des-

296 CASES OF HYDROPHOBIA.

troying the part into which the *virus* is infused, is indispensable, and the most important, without which, all the other proceedings are uncertain; and, that among these last, such as disorder the animal œconomy, or strongly affect the nerves, expose the patient to more or less danger. (*Hist. de la Med.* p. 2.)

Happy will it be, if this indecision respecting internal remedies, excite an early and cautious care of the unfortunate objects of these Memoirs; and also, make the practitioners of the healing art more successful in their future applications, and, in the mean time, diligent in the use of the best means already discovered.

Worcester, Dec. 24, 1785.

Additional

XII.

Additional Case of HYDROPHOBIA.

THE 7th of August, 1788, I was requested to attend Mr. *John Taylor*, aged fifty-five, a farmer, at Burcot, near Bromsgrove: about four months before, he was bit in the right wrist, by a mad dog; for which, he had taken for three weeks powders of cinnabar, and, *Æthiop's mineral*; and was dipt or bathed, in the usual manner, in seawater.

2d of August. Saturday. Unwell, and symptoms of Hydrophobia approaching.

3d of August. Sunday. Complained of pains shooting from, and along the right arm, to the shoulder,

shoulder, and from thence along the neck to the throat.

His sleep disturbed; when roused he sighs, and was hurried and depressed, with a reluctance to swallow fluids.

4th of August. Monday. He was visited by Mr. Collet, surgeon, in Bromsgrove, in the absence of Mr. Woodcock, the surgeon and apothecary he usually employed. Mr. Collet observing him turning from water, with uncommon horror, suspected the nature of the disease.

5th of August. Tuesday. The aversion to liquids increased: the misfortune of his having been bitten was recollected; and it was now firmly understood, that the dreadful disease Hydrophobia, was that with which he was affected.

The sight, and the noise of a fluid, as well as the touch of it, and, its approach to the mouth, produce violent emotions, and sighing, with spasms extending to his hands, and every part of his body; with an inexpressible horror and agony. Yet he does not know his complaints proceed from the bite of the mad dog: and, to use his own words, "He cannot conceive what is come to him, that though he is very thirsty, the approach, look, and taste

taste of drink, should, even in thought, so much afflict him."

He eats and swallows soft toasted bread, potatoes, and roasted aples, at the same time, tolerably well.

6th of August. Wednesday. This day he began to take medicines well adapted to his case, by the direction of Mr. *Woodcock*.

7th of August. Thursday. 'About six o'clock in the evening, when I visited him, he had taken five doses of the following bolus.

R. Extract. theb. gra. i.
Turpeth mineral. gra. iii.
Conserv. rosar. q. s. f. bolus.

Besides this, a powder of calomel and sugar, to the quantity of a drachm, had been rubbed within his mouth; and an ounce and half of ung. coerule. fort. had been rubbed upon his body.

Under this course, he had vomited several times in the night, and this morning. He also had several stools, and made water.

But the Hydrophobia was not abated, and I
heard

heard him wonder at his aversion to liquids; which I saw exemplified, in a manner that forbid the encouraging a repetition of the terrible struggle the patient underwent.

His pulse beat only sixty-four strokes in a minute, and frequently intermitted.

I ordered the mercurial plan to be continued and enforced, without intermission: and being anxiously desirous to hasten salivation, he was fumigated in my presence, with cinnab. factit. and calomel; a drachm of the first, and half a drachm of the last, were, I believe, raised in fume before I left him: which he bore tolerably well, yet not without a certain degree of hurry, though the pulse ceased to intermit.

I directed a vomit, of six grains of turbith mineral, to be given immediately, unless he before vomited.

The fumigation to be repeated every six hours; and half a scruple of calomel to be taken also every sixth hour, in the intermediate spaces.

The following ointment was to be rubbed in thrice, in the twenty-four hours, till he began to salivate.

R. Cam-

R. Camphor. drach. i. solve ol. fuccin. q. s.
Ung. cærul. fort. semi unciam. f. unguentum.

A blister to be applied to the right wrist, where he had been bitten: and milk and calves-feet broth were directed to be injected by glyster, four or five times in twenty-four hours, with the addition of tinct. opii. gutt. xxiv. to each glyster.

These directions, however, were very imperfectly executed, as the patient was left to the care of an assistant, who had not that influence and authority, which is indispensably necessary to overcome the reluctance patients in that miserable state have to efforts of every kind, even those most necessary to their recovery. So that after my visit, he had only one of the calomel powders, and one turbith bolus; two or three glysters, which remained in the body; every thing besides was laid aside, except a repetition of the mercurial unction, twice or thrice more, so that the quantity rubbed in, amounted nearly to three ounces.

He continued restless this night, (Thursday,) at times delirious, though with intervals of sense. In general he had no sleep.

8th of August. Friday forenoon. He took milk and whey in a spoon, and swallowed to the quantity.

tity of a pint: and continued taking milk or whey, in this manner, the remainder of the day, with tolerable ease, though it was necessary to press his nostrils, in order to promote his swallowing: and in this point he seemed much relieved, till near the time of his death.

This day, all medicine was given up: Mr. *Woodcock* found him delirious in the succeeding night, and raving to the greatest degree; and in this state he continued, till near the time he expired, which happened about one o'clock on Saturday morning, the ninth of August. Though he spilt much about him, the evening preceding his death, yet no mercurial salivation had been raised by the mercurials he had applied to him.

This melancholy case suggests one or two observations.

1. It is remarkable, that so large a quantity of mercury, internally and externally applied, excited no salivation. Quere? Does the impression of the poison on the nervous system, render it insensible to the action of mercury, and, to a considerable degree, unimpressible by it?

2. Though this fatal case is not much in favour of mercurial remedies, neither is it absolutely unfavourable.

favourable. The length of time the patient survived from the first seizure of Hydrophobia, was at least seven days: and his having been able to swallow fluids, in a considerable quantity, with less aversion than at first, may be imputed to the method of treatment, and principally to mercury; and it is to be lamented, that it was discontinued too soon.

3. In more than forty years attention to medical studies, this is only the second patient labouring under Hydrophobia, which has come under my immediate observation; and the first under my direction. The rareness of the disease, in one point of view a happy circumstance, has probably been the occasion of its remaining incurable.

By a combination of circumstances, medicines were not very early applied in this case, or steadily continued: and the disease being both terrible and rare, the consternation of the attendants most generally prevents such a resolute perseverance, in remedies, as the nature of the calamity requires; and thus the patient is abandoned to his sad fate: from such circumstances it happens that this disease, though it may be not in its nature incurable, is still ranked among the opprobria medicorum.

Hence every addition to the certainty of prevention,

tion, should be carefully followed. The method proposed by my ingenious friend, Dr. *Haygarth*, of pouring warm water upon the bitten part for a very long time, is so easy in application, and so likely to be successful, that it should always lead the way in every prophylactic process, and particularly in that I have recommended in the former essay.

4. I have frequently, in nervous and highly spasmodic affections, observed a considerable difficulty and struggle in swallowing either solids or liquids: but the specific horror to liquids, as such, was wanting. I have also met with patients, who, from terror, believed themselves affected with Hydrophobia and canine madness. The symptoms have been such as made practitioners often believe, the patients laboured under the genuine Hydrophobia; and the treatment which succeeded in curing such maladies, has been held out as an effectual cure for that disease. This accounts for the credit medicines have in all times acquired, as remedies for the Hydrophobia; and for their failure, when tried in the genuine Hydrophobia.

Many physicians, of great experience in other diseases, have lived and died without seeing one case of true canine Hydrophobia: that nervous diseases should, in some cases, impose upon such persons,

persons, I can readily conceive: but whoever has seen *only one patient*, labouring under the true Hydrophobia, can never afterwards be mistaken, or misled, by any appearances resembling it: with such strong, and inexpressibly pathetic signatures, is the horror to liquids, marked in patients, labouring under this dreadful malady!

5. The saliva of rabid animals, appears from the best evidence, to be the only vehicle of infection. And, there is no proof of its being communicated by milk, blood, feminal liquors, or sweat. The milk and flesh of mad animals, have been taken internally, without any bad consequence.

It is matter of doubt, indeed, by what channels the infection is conveyed into the salivary glands, as no evidence evinces its having been absorbed by the lymphatic vessels only, as the variolous, and some other poisons are.

It may be diffused in the mass of circulating blood, in a state fit to furnish the matter for the poisonous secretion, which takes place in the salivary glands of the tainted animal, though the blood only be incapable of giving the disease.

Thus the blood of persons infected with the small-pox, appears incapable of communicating
X the

the disease by inoculation, and yet the pustules separated from it, disseminate that disease.

Thus, too, bile, semen, common saliva, and other liquors secreted from the blood, are nevertheless totally different from it.

Quere. Does not the tainted saliva of rabid animals, mixing with the fluids, and affecting the nerves, give a peculiar morbid action to the salivary glands, fit for the assimilation, or, preparation of the poisonous saliva?

However the poison is formed or conveyed, it is evident, from the taint the saliva ultimately acquires, that its action is not limited to the part injured; though one of the early marks of injury, may be pain in that part; as happened in the case I have last related.

Nevertheless, I agree with an ingenious observer,* that ablution and excision of the part, ought at no time to be neglected, if omitted at first; and, that it may even be useful, when the patient is afflicted with the Hydrophobia.

Cynanche

* Dr. White, St. Edmundsbury, in Medical Memoirs, third vol. p. 608. And, in such unhappy circumstances, when nothing probable ought to be omitted: particular regard should be given to the case of a patient, afflicted with the symptoms of Hydrophobia, successfully treated with sweet oil, used internally and externally, by Dr. Shadwell. See Med. Mem. vol. ii. p. 454.

XIII.

*Cynanche Pharyngea: or, Defect of DEGLUTITION,
from a straitning of the ŒSOPHAGUS.**

LORD BACON, in the work "De Augmentis Scientiarum," incites physicians to attempt to lessen the number of fatal diseases by new methods. Impediments to the passage of food into the stomach, from a stricture, a thickning, or scirrhous of the pharynx, or in some part of the œsophagus, is so frequent, and so very justly accounted a dangerous and fatal disease, that I hope any reasonable endeavour to obviate its danger, will not be unacceptable.

Every one must have had experience, that this disease has resisted the most powerful remedies. *Van Swieten*, in his comment on § 797 of *Boerhaave*, gives a catalogue of medicines, applied in this case by himself, and other physicians, and all

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* See Art. xvii. Med. Mem. vol. ii.—Read June 4, 1787.

in vain. The tartarus tartarifatus, and regeneratus. *Starkey's* celebrated penetrating soap, composed of oil of turpentine, and salt of tartar. Crude sal ammoniac, and its volatile spirit, saturated with distilled vinegar, applied both outwardly and inwardly, with sufficient perseverance, either did no good, or only gave a short and temporary respite, from a disease, which soon returned as bad as before.

Mercurial unctions, and mercurial plasters, with the gums, applied to the neck, strong purges, and even salivation itself, were unsuccessful. Emollient decoctions, oily and lubricating medicines, were often serviceable, in rendering the passage more open, so long as any passage remained, but did not cure effectually and radically. The recent roots of the black hellebore, beat to the consistence of a cataplasm, with vinegar of squills, and bryony root, pounded with crude sal ammoniac, and applied to the neck, failed. A probe, with sponge, fixed on whalebone, and introduced into the œsophagus, to force open the stricture, was ineffectual, and manifestly hurtful, by irritating that sensible part, and encreasing the pain and swelling in it.

I knew a murder committed, (I hope the faculty will pardon the expression,) by an attempt to open a passage into the stomach, by this kind of forcible entry.

I have

I have found lubricating oils, burnt sponge, and mercurial unction, fail; I fear, when the Œsophagus is much thickened, or, when a scirrhus blocks up the passage, medicine will be of little service: yet, in this unhappy situation, a method may be adopted, which promises some good, and which entitles it to a preference to medicines of an irritating and stimulating nature. All the good that is to be done, will be effected by relaxing, or gently dilating the stricture. For this last purpose, bougies of a proper size might be tried, as proposed, very judiciously, by Mr. *Watben*, and endured without pain, or retching to vomit; and, especially if followed with any advantage, they ought to be continued, and, from time to time, repeated; if otherwise, certainly laid aside. The advantage is most likely to be secured, by giving bolusses of butter, and other oily substances. I certainly have seen some palliative good done by oily linctusses. The food ought always to be milky, demulcent, nutrient, soft, and-liquid. Though I have hardly ever seen mercurial unctions useful, I remember curing a person, by giving corrosive sublimate, dissolved in the spirituous tincture of Peruvian bark, in a manner similar to the celebrated solution of *Van Swieten*. A spongy, relaxed appearance, in the uvula and glands of the throat, led me to administer this medicine, which I, by no means, think likely to be generally useful.

Opium, and extractum cicutæ, bid fair, in my opinion, to be more generally useful in this disease, than any other medicines. They will operate powerfully in removing the spasmodic stricture, which sometimes is the sole cause, and more or less attends every other cause of this disease. I remember a young woman, still alive, who, without any inflammation, swelling, or apparent cause in the throat, for several days, laboured under this disease of the œsophagus, so that no solid or liquid food passed into the stomach. She was cured by taking fifteen drops of thebaic. tincture, on sugar, every four hours. She took six doses in this manner, before the stricture yielded to the medicine; but has remained well, and free from the disorder, ever since the year 1780. I judged her disease proceeded from spasm; but think it highly probable, that if it had not been removed by the medicines, a thickening of the œsophagus would soon have ensued, and the disease have become permanent and incurable.

In 1782, I was consulted for ——— *Robinson*, a tenant of *W. Childe*, Esq. of Kinlet, and who used to accompany him in the sports of the chace. He had, for a considerable time, laboured under a disease, reputed incurable, which had prevented all food from passing into the stomach, from an obstruction below the pharynx. I ordered a grain
of



of extract. thebaic. with a few grains of extract of hemlock, to be taken in the form of pills, two or three times in the day, but to hold them in the mouth till dissolved, and to swallow the solution with the saliva; and to avoid every attempt to take any thing else, which might bring on straining, and force the medicine back again. By adhering to this method a few days, the obstruction was removed, and the power of swallowing solid, as well as liquid food, was perfectly restored. The disease, however, returned, and was fatal to him, about three years afterwards. I imputed this to the habitual indulgence of drinking spirits and drams; and it is somewhat remarkable, that he, after this relapse, neither used the method, nor the assistance of him who had administered relief, till it was visibly too late to be useful.

I have applied the same method and medicines, since that time, in several instances; and from the success, I venture to recommend the plan, in preference to any hitherto in general use for this formidable malady.

When the pressure of swelled glands is found to be the obstruction to deglutition, which I remember to have happened in some cases of bronchocele, and which may be suspected, if the patient has knots in the glands of the neck, or any other

marks of scrophula. In such circumstances, the deobstruent medicines, which are specifically proper in scrophulous diseases, are indicated. In order to give such medicines efficacy, it is necessary to apply them topically to the absorbing orifices of the lymphatic vessels, which enter into the obstructed glands, and again emerge from them, in their course to the lacteal duct, where it disembogues its contents into the subclavian vein. This is a point of great importance; for, being thus applied, medicines will, very probably, go in full power and efficacy into the obstructed glands.

Medicines which are conveyed into the body by the lacteal vessels, have no such advantage. They mix with the blood, and, circulating with it, have only a remote chance of ever arriving at the seat of the obstructions intended to be removed. In order to arrive at these glands, they must be thrown out in secretion, and again absorbed by the lymphatic vessels, which are to convey the lymph to the glands in question, and, along with that lymph, these specific medicines; a piece of luck, if duly considered, hardly to be expected.

It is therefore certain, that the holding the medicines directed for the bronchocele, under the tongue, till gradually dissolved, is, in the highest degree, a rational practice, and, indeed, found such

such by experience, long before this reason was thought of, as being necessary to their efficacy.

I prescribed for a lady of a scrophulous habit, and who has had repeated returns of an obstruction in the passage of food along the œsophagus, the following bolus :

R. Spong. ust. Flor. Martial. a ʒi.

Conserv. Rosar. q. s. f. Pila sublingualis.

which she was ordered to hold under her tongue, till dissolved, and to swallow the solution ; this she did for a fortnight or three weeks, at bed-time every night, and has been constantly cured by it.

I am certain the same mode of administration, will add greatly to the power and efficacy of any other medicine, which may be thought proper in such circumstances. But early application to medicine is, in this, as in all other dangerous diseases, of the utmost consequence to its success.

1841

THE

REPORT

OF THE

COMMISSIONERS OF THE

LAND OFFICE

FOR THE YEAR 1841

IN

ANSWER TO A RESOLUTION

PASSED BY THE HOUSE OF COMMONS

ON THE 12TH OF MARCH 1841

AND

TO A RESOLUTION

PASSED BY THE HOUSE OF COMMONS

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AN
E S S A Y
ON
MINERAL POISONS.

BY
JOHN JOHNSTONE, M. B.
OF MERTON-COLLEGE, OXFORD;
FELLOW OF THE MED. SOC. OF EDIN. AND LONDON;
AND LATE PHYSICIAN TO THE INFIRM. WORCESTER.

1795.

ADVERTISEMENT.

THE following Essay forms part of a collection on medical jurisprudence, which the Author hopes, some time or other, to lay before the public. In publishing it, he has submitted to the, perhaps, too partial opinion of those, whom he is equally bound by duty and inclination to respect; and who thought, that it would form a proper practical continuation and appendix, to some of the tracts contained in this volume. He is fully conscious of the defects of his work, and how small a claim it has to public attention; yet, he trusts, that he shall meet with some indulgence, when it is understood, that it

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was originally drawn up, not for the inspection of medical men only, but for the use of a profession whose education, though most liberal, cannot be expected to comprehend subjects, so remote from their more general pursuits. To adapt it to its present situation, and to render it more capable of general utility, a sketch of the mode of action, and of the cure of each poison, has been added. It may appear inconsistent, to publish in the same volume, sentiments so different on the same subjects, as will appear in the following Essay, from those of some of the other tracts. But whenever he differs, though it is with deference and respect, yet it is without regret, being well assured, that many a spark of truth has been struck, by the clashings of opinion, and that the cause of science, must eventually be advanced by all moderate and sober discussion.

Birmingham, Dec. 1794.

AN

AN E S S A Y

ON

MINERAL POISONS.

THOSE mineral substances, which, when taken internally, or applied externally to the bodies of animals, in certain small quantities, prove universally hurtful or destructive to them, by a sudden and specifically deleterious operation, are called poisons. I say, that in certain small quantities they prove hurtful, by a specifically deleterious operation, because *all* the mineral substances are dangerous, when taken in excess. A small quantity of chalk, or sand, will pass through the bodies of animals without danger: but the stomach may be so clogged, by a large quantity of these substances, as to endanger life, and even to destroy it. It would

would be absurd however, to rank chalk, or sand, among the poisonous minerals, because from their bulk they might produce these effects, since, in no case, can they be denominated specific. A large quantity of flour; of the most simple and innocent article of food, may be crammed into the stomach in such a manner, as to destroy its action, and therefore, with equal propriety, might be called poisonous.—It would be equally absurd to exclude from the list of poisons, all those substances which may be given to animals in very small quantities, without injury. Considering the subject in this view, the word poison should be expunged from language, as probably even animal poisons will not produce their contagions, unless in certain quantity; and we are acquainted with no powers that act in smaller quantities than these. The portion of variolous matter, diffused through the hundredth part of a grain of pus, will produce the contagion of the small-pox.

The idea attached to the word poison, in English, is clear and appropriate, and corresponds to the action I have now defined: it is so too in French, Spanish, Italian and German, and, as far as I know, in all other languages of Europe. In Latin and Greek,* the meaning is double: PHAR-

MACON

* R. Stephani Thesaurus in Veneu. Aulus Gellius, Lib. xii. chap. ix.

MACON signifies a remedy, as well as a poison; and *venenum* is not always to be understood as a poison.

The mineral poisons may be divided into two classes; those whose operation is so sudden and obscure, as almost to baffle conjecture; and, those whose operation we can partly explain, as proceeding from their acrid or corrosive qualities. Suddenness of effect, is a necessary quality of a poison. Lead, swallowed or absorbed, in small portions, seems, at first sight, to afford an exception. But when we consider, that these small portions are accumulated in the body, and that the operation does not commence, till a sufficient quantity to produce action is accumulated, the objection vanishes. A certain quantity of arsenic may be swallowed, without any apparent injury: so may a certain quantity of lead. But each of these poisons will produce its appropriate effects, if repeated; nor can either the one or other, be denominated a slow poison, because, when administered in small quantities, and at intervals, a longer time elapses before they produced them. The present state of our knowledge, does not furnish us with any poison, and perhaps none such exist, as that which, from a single dose, produces no immediate effect, but takes the time of weeks, or months, slowly to consume the vital principle. The effects of a dose of poison, may be so far overcome by strength of constitution,

situation, or the judicious administration of remedies, as not to prove *immediately* fatal; yet the patient may linger many months, and, at last, sink under the debility occasioned by its operation: but, as this is not its usual operation, it should be considered no more as a slow poison, than a wound, which nine hundred and ninety-nine times out of a thousand proves fatal, is not to be considered of a genus of wounds that are mortal, if by chance it should be healed.—In all reasonings and judgments upon any case, our arguments should be guided by general, and not particular, events.

Before I enter on the enumeration of the several mineral poisons, and their effects, I must beg leave to anticipate some remarks.

“On few of the poisons he enumerates, has the author made any experiments himself. In support of many of his reasonings, he has adduced analogies, instead of actual facts: and, in many of them, he is not supported by a sufficient weight of the authority of others.”

To the first objection, I must plead guilty; nor have I any other apology to make for the neglect, than a species of weakness, which incapacitates me from making those experiments on animals, which expose them to great and continued torture. Some attempts

tempts I have made, of this kind; and I must own, with shame, that the consequences have determined me, never to repeat them. Experiments with vegetable poisons, by which, probably, sensation is immediately destroyed, or on those subjects in which the source of sensation is cut off, may always be made, without pity or remorse: as it can be of little consequence, whether we destroy the lives of animals for food or for information, provided they are destroyed with the least possible degree of pain. From the facility with which this kind of experiments may be made, there cannot be wanted opportunities of gaining every necessary information on the subjects in question; nor is that information, particularly with respect to mineral poisons, of such consequence, as to induce any one to make a considerable sacrifice to obtain it, No one will surely risque much, where much cannot be gained.

It will not be necessary for me to insist on the use I have made of analogy. Every one who thinks, must observe, that the greater part of our knowledge of poisons, must be derived from this source. Few are the instances, in which we have an opportunity of observing their effects on the human body; and can any one wish them to be more numerous? The practices of *Herophilus* and *Erasistratus*,* can never again be tolerated, whilst

Y 2

humanity

* Qui nocentes homines vivos inciderint. Celsus in Prefat.

humanity and reason retain their empire over mankind. I must confess, that in some few cases, I am not satisfied with the only authorities that I have been able to adduce : yet I have turned over every author in my power, who was likely to afford illustrations, and have availed myself of their assistance. For other parts of my work, the materials I found were ample : these I have gladly used, and with them, I trust, the reader will not be dissatisfied. In general, however, the authorities are far more scanty, than might be expected. I cannot give a better instance, than in referring to *Mead's* elegant treatise on poisons.

The Mineral Poisons are either metallic; earthy; or saline; or compounds of one or other of these

I. The Metallic Poisons are:

ARSENIC,	COPPER,
MERCURY,	LEAD,
ANTIMONY,	SILVER, and GOLD.

II. The Earthy Poisons are :

CALCARIOUS EARTH, BARYTES, or ponderous Earth, and SILICIOUS EARTH.

III. The

III. The Saline Poisons are :

The SULPHURIC, and the MINERAL,
 NITRIC, ALKALI,
 MURIATIC ACIDS,

I. The compounds of these poisons are, in general, more virulent than the simple substances; and some of them become poisonous *only* by combination.

1. ARSENIC, is soluble in water, and in all the acids and alkalies. It is often found naturally combined with many of the metals; and, by art, it may be combined with all of them. The base of arsenic consists in an acid, which is procured by chemical analysis. It is this acid that unites so readily with alkalies, and which may also be joined to sulphur, metals, and earths. With sulphur, the compound becomes, to a certain degree, innocent. All the other compounds are poisonous, in proportion to the quantity of arsenic they contain. As it is not my business to dwell on the different preparations of arsenic, I beg leave to refer the reader, for a more particular account, to the second volume of *Burgman's Essays*, which contains a great number of good facts; although the theory by which they are explained, be now exploded.

It is before remarked, that all the compounds of arsenic are noxious, in proportion to the quantity they contain of the mineral: thus they are all milder than the pure acid. The regulus is less active than the white oxyd; and, perhaps, the neutral salts of arsenic, with alkali, are more mild than any of its other saline preparations, when there is no superabundance of acid. I do not, however, insinuate, that *any* of its preparations are void of danger. Sulphur softens the acrimony of all the noxious metals; and yet they are not always to be trusted to, even when combined with it. The action of the stomach upon all the compounds that have one deleterious ingredient, may be such, as to let it loose in all its native malignity: none of them are ever to be implicitly trusted, since accident may uncombine them.

2. MERCURY, in its native state, is entirely harmless; it becomes active only by combination with oxygene, or saline substances. With the three mineral acids, it forms the most active preparations. With the muriatic acid, it sublimes into a poison as malignant and deleterious as the oxyds of arsenic, commonly called corrosive sublimate. With the nitric acid, it forms another corrosive poison, less virulent, indeed, than corrosive sublimate, but equally capable of destroying animal life, when administered in sufficient quantity. Its compound
with

with the sulphuric acid, is neither so corrosive, nor so fatal, in its usual operation, as the former two; still, however, its activity is such, as to be capable of producing very dangerous consequences. There are other preparations of mercury, resulting from combinations with different quantities of acid, or alkali, &c. which, though less active than either of those I have now enumerated, are far from being void of such a degree of stimulating power, as to render them innocent. The oxyds of mercury, are active in doses of three or four grains; they may prove, therefore, very dangerous stimulants, in the quantity of a drachm, or even of a scruple.—Sulphur renders mercury, as it does most of the other metals, to a certain degree, inactive. Compounds of this sort, are often given in large quantities, without bad effects.

3. **ANTIMONY**, is usually found united with sulphur, and in this state is inert. The pure oxyds shew but little activity, unless they meet with acid in the stomach, and then they are violently stimulating, in the smallest dose. With acids, antimony shews all its power, and its preparations yield, in violence, in no respect, to those of mercury. With the muriatic acid, it forms a corrosive compound, commonly called, butter of antimony; which can be compared with the muriated mercury, for violence. Its oxyds are active in much smaller quantity than those of mercury.

4. COPPER, is one of the minerals the most universally poisonous we are acquainted with. In all states, it is noxious to the bodies of animals; nor do I know of any combination that neutralises its baneful qualities. Water, the animal fluids, the acids, alkalies, and oils, all bring it into action. The list of its poisonous preparations is not circumscribed by any exception, unless sulphur affords any; as copper, in every form, is deleterious to animals, in proportion to the quantity taken into their bodies.

5. LEAD, in its metallic state, is not so readily acted upon by the aqueous liquors, as copper; it is therefore not so dangerous, when swallowed in this form; and in no state is its action so quick, as that of copper. Its combinations, however, are as various; and, in other respects, there are as few exceptions to its malignity. — With acids, lead forms its most active preparations.

SILVER and GOLD.

6. SILVER, affords only two poisons. The first is, when joined with the nitrous acid; the other, an oxyd of this metal, precipitated by means of ammoniac, called fulminating silver.* The first is

* Journal de Physique, 1788. — p. 474.

is one of the most corrosive substances we are acquainted with: the other, I never knew taken into the body, and consequently cannot judge of its effects but by analogy. It is, probably, one of the most inflammable substances in nature, as it inflames at a degree of heat little above that of the human body, with a most tremendous explosion.

Of fulminating GOLD we have some clearer knowledge. "In duobus Ægrotis (says *Plenck**) a tribus granis auri fulminantis tormina, ingentem debilitatem & profusissimam vidi salivationem." He quotes instances when death was even produced by it. *Rolfincius* gave it to the quantity of six grains, and it only operated "Commotum alvo:" and *Bergman*† quotes other authorities for its diaphoretic powers; but does not hint at any extremely violent internal operation. There are many shades between tormina, and, commotum alvo, especially when we consider, that the greater effect was produced by the smaller dose.

BISMUTH and ZINC, are ranked among the poisonous minerals by some authors; in my opinion, without sufficient authority. Bismuth is, and has been long, so largely employed as a cosmetic, and a paint,

* De Venenis. — p. 241. — Note.

† Physical and Chemical Essays. — Vol. ii. p. 140.

a paint, that it is hardly probable, but its peculiar qualities would have been detected, was it peculiarly hurtful.* We must not argue from the similarity of its general properties to lead, as it is well known, that many chrystals and fossils have all the marks of external similarity, without the least resemblance in action.

ZINC, has a much better claim to the title of poison, on account of the activity of vitriolated zinc, which acts as an emetic, in the quantity of fifteen or twenty grains. It is most probable, that active compounds are formed by its union with the other mineral acids: but this I do not know from my own experience, nor can I assert from that of others. The action of vitriolated zinc is such, that I think it will seldom stay long enough in the body, to produce any hurtful effects, in whatever dose it be taken. The pure oxyd, can be given to the quantity of ten or twenty grains, often without any apparent effect; and when it does operate, only with sickness. At any rate, none of the preparations † have a specifically deleterious operation;

* *Nihcolson's Elements of Chemistry*, p. 342. — *Hoffman de infec. Med.* tom. vi. p. 315.

† *M. de la Planche* swallowed salts, formed by zinc with vegetable acids, in much stronger doses than could be contained in any aliments, prepared in copper vessels plated with tin, without suffering from them any bad effects. — *Fourcroy's Elements of Chemistry*, &c. vol. ii. p. 299.

operation; and have, therefore, no better claim to be ranked among the mineral poisons, than ipecacuan has among the vegetable.

Some of the other semi-metals, have been found occasionally poisonous; but as this happened from an admixture of arsenic, there is no reason for admitting them here.

So little is known of the compounds of PLATINA, that I cannot say, whether they are ever deleterious or not.

II. With the Earths, the poisonous combinations, luckily for mankind, are few.

1. In its pure state, CALCARIOUS EARTH is so caustic, that it must prove deleterious when taken internally, or applied even externally, in large quantities: in this form it is called quick-lime. When combined with carbonic gas, which it is always found to be in a state of nature, it is entirely harmless. Combined with a pure, or, as it is called caustic alkali, quick-lime becomes much more corrosive, than even in its purest state. All the other combinations are quite innocent.

2. BARYTES, is always found united to a considerable quantity of carbonic gas; and I much doubt,

doubt, whether it be harmless, even in that state: when the gas is expelled, it becomes, in most respects, like quick-lime, with all its corrosive qualities. With the muriatic acid, it forms a compound, which, by experiments on dogs, has been found deleterious.

3. SILICIOUS EARTH, cannot be said to be poisonous, in its natural state; though, when mixed with alkali, and fused into glass, it affords a substance, which, by its mechanical action, is capable of doing the greatest injury to the stomach, and thereby of destroying life. In the same way, the natural compounds of silicious crystals, must be supposed to act. It may, perhaps, be too curious, to add these to a list of poisons; as, with equal reason, small pieces of sharpened iron, might be ranked among these deleterious powers. I have purposely omitted many others; such as SELENITE, CALCARIOUS CRYSTALS, &c.

III. All the concentrated Mineral Acids, are highly corrosive; therefore, when swallowed undiluted, they are noxious to animals.

1. The SULPHURIC ACID, is most common; but none of its compounds, except those with oxygen, are more corrosive than itself alone. Its acrimony is not corrected by admixture with the other acids,

as it is, to a great degree, by combination with alkalies. This acid is rendered more or less caustic, by the greater or less proportion of oxygene joined to it. — This is indeed the case with all the mineral acids

2. The NITRIC ACID, is more corrosive in its most oxygenated state, than the sulphuric, and is more active than any of its own preparations. With the muriatic acid, it forms a very caustic compound, called aqua regia, on account of its power of dissolving gold. With the alkalies, its neutral salts are far from being inert, though they are infinitely less active than the concentrated acid.

3. The MURIATIC ACID, in the state we commonly meet with it, is very corrosive; but its powers are wonderfully increased by the addition of oxygene, in double quantity: it is then, probably, one of the most powerful solvents in nature. Combined with mineral alkali, it forms common salt, which certainly cannot be denominated poisonous; and with other alkalies, its compounds are far from being remarkably active.

4. Of the Alkalies, that which is called SODA, or NATRON, is the only one that is indisputably mineral, and even this is prepared in great quantities, from plants. But it exists in such prodigious

digious abundance in the waters of the ocean, and in an uncombined state, in some particular parts of the earth, that its origin is rendered certain. The mineral alkali, collected from sea salts, or by any of the usual modes of collecting it, is always found united to a very large proportion of carbonic gas. In this state, it is sufficiently active to prove hurtful to animal bodies, when taken in large quantity: but its powers are not fully unfolded, till all the gas is expelled; it then becomes so corrosive, that it has obtained the name of caustic alkali. When united with acids, it is converted into salts, mild in proportion to the acridity of the ingredients, though in most cases, retaining a certain degree of activity.—When mixed with pure calcarious earth, or barytes, the compounds are more caustic than either of the original ingredients.

What is said of the Mineral Alkali, will apply to the VEGETABLE and VOLATILE, for the most part; reckoning a greater degree of activity in both of these.

I have thus hastily sketched an outline of all the Minerals, and their compounds,* which are poisonous,

* I say all, because I know no more. Whether others may be generated in the progression of things, can only now be a speculation. Buffon thinks, that animal substances may be converted into poisons, by long maceration and decomposition. He observed little darting spicula,

fonous, when taken internally, or applied to the bodies of animals. I shall now proceed to determine their effects; and shall rest, with encreased attention, upon the poisons, whose virulence has long excited the terrors of mankind, from the smallness of the quantity in which they prove fatal. Those whose corrosive qualities are evident to the touch, and that act in a mechanical way, will require less investigation.

I.

METALLIC POISONS.

1. **A**RSENIC,* in all forms, that with sulphur alone excepted, is a sure poison in doses of six or eight grains, when taken internally; and, in some cases, it proves fatal in the small quantity

cula, which, from their resemblance to the poison of the viper, observed by Mead, he thought might be poisonous. People now will probably account for this appearance, by the chrysalisation of the sthio, or some other acid. — History Nat. Tom. iv. p. 145.

* Pliny mentions arsenicum slightly, as a corrosive.—Nat. Hist. 34. 13.
Arsenicum,

quantity of two,* three, or four grains. It is corrosive to the taste, and the sensation remains upon the tongue for a long time. If the white oxyd be tasted, the taste is first of all acid, and subdulcid; which afterwards becomes penetrating and corrosive. When swallowed, this penetrating and corrosive taste, extends all down the throat, and is soon followed by great heat, and contraction of the œsophagus, irritations, and nausea. Slight and aching pains then succeed, which gradually encrease to enormous anguish. Incessant vomitings also come on; the pulse becomes quick; the tongue and throat parched with heat, and intolerable

Arsenicum, sandaracha, auripigmentum, are mentioned by *Celsus*, as “quæ rodant, quæ purgent, quæ exedant.”—Lib. v. c. 5, 6, 7, 8. But, in general, the ancients are not to be quoted as authorities concerning the action of poisons; and perhaps they were unacquainted with the more virulent preparations of arsenic. Their opinions of their nature and operation, were as absurd as their fears of them. Among the reasons for thinking that *Germanicus* was poisoned, *Suetonius* says, “Nam præter livores qui toto corpore erant, & spumas quæ per os fluebant, cremati quoque cor inter ossa incorruptum repertum est, cujus et natura existimatur ut tinctum veneno, igne confici nequeat.”—Lib. iv.

The long lists of antidotes, *Mithridate* and *Theriac*, that we derive from the ancients, are a potent proof of their terrors, and their ignorance.

* A lady put some arsenic into her mouth, to taste what it was. When she discovered that she had been tasting poison, she would use no preventive, believing that she had swallowed none of it. Twelve hours afterwards, she was seized with vertigo, and her body was universally convulsed. She continued in this state a day and night; an eruption at the same time breaking out, like measles. She partly recovered in five days, but was an invalid for many years.—*Edin. Med. Essays*. iv. 41.

terable thirst. Excessive anxiety is felt in the chest; and respiration is performed with difficulty and distress. The limbs are affected with tremors and cramps; and the body, flushed and spotted, at last swells to an immense size; when suddenly the pains abate, and the by-standers flatter the patient's recovery of health. But all the other symptoms continue unabated: the pulse is quicker than ever, the intolerable sense of heat and thirst is rather aggravated, delirium comes on, with hiccup, cold sweats, and convulsions, the countenance contracts a leaden hue, and death puts an end, at once, to torment and to hope.

This is the general course of the symptoms; but they are often varied in particular cases. Sometimes the delirium and convulsions accede early, and during the more violent action of the poison, but more commonly towards the close. The vomiting is generally tinged with blood; and sometimes the discharges by urine and stool, are also bloody: but these effects take place less frequently when the action of the poison is quick, than when it is protracted.*

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On

* For an account of the symptoms, &c. see *Mangeti Bibl. Med. Pract.* Tom. iv. p. 821.

Lieutaud Hist. Anatom. Med.—Vol i. p. 39. obs. 154.

Weyfer Cicut. Aq. Hist.—C. xxi. 3.

Morgagni de sed. & causis Morb. fix. 3. 6.

On dissection, the mouth, œsophagus, and stomach, are always found inflamed: the stomach particularly about its orifices; and its coats are so much intenerated, that a finger can be passed through them with a slight degree of pressure: 'tis also frequently corroded; and the corrosions are so peculiar, that they may be distinguished, with care and attention, from those of the digestion of the stomach, by the gastric liquor. From the gastric juice, the corrosions are jagged and irregular, and are only observable in the depending parts of the stomach. From arsenic, they are regular, as if nicely punctured by an instrument, and are observable in all parts of the stomach which the poison has touched, surrounded by the appearances of inflammation.

The duodenum, and small intestines, generally partake, in some degree, of the inflammation, and subsequent mortification. Wherever the poison touches, there will be inflammation, and an uncommon secretion of mucus; and it may be carried through the whole extent of the intestines. Little information can be gained by examining other parts, than those immediately affected by the poison: with this view, the stomach and intestines should be minutely examined. We should not rest contented with merely inspecting the stomach; particles of poison may be pushed forward,

as far as the rectum, and produce their effects through the whole extent of the alimentary canal.

The brain never shews any particular mark, by which we may judge, whether a poison has been taken. The lungs are sometimes interspersed with black spots, and the right auricle of the heart is generally full of black blood. These appearances, probably, arise from the difficulty of respiration, or from its sudden interruption, and, are no criterions of poison; they are commonly observed in all cases of sudden death.* The scrotum, and genital parts of men, are said to grow very soon putrid after death, from the poison of arsenic. Whether this is always specially the case, I do not know: certain it is, that the whole body much sooner assumes this appearance, than after any other cause of death, that is not equally sudden.

On examination of the contents of the stomach, if arsenic were taken in its pulverised state, grit will be perceptible by the fingers; and in the smallest quantity, it will constantly sink in water.

Z 2

At

* Black spots in the lungs, are always remarked as following death in all cases of poison. I do not believe that they are any thing more than coagulations, from the sudden stoppage of circulation, and that they generally will be observable, when death occurs suddenly, in full health.

— *Wepfer* mentions them, as appearing in the lungs of a woman, who was opened while yet warm, after being beheaded. — *Cicut. Aq. Mist. cix. p. 150.* And I have seen them twice in healthy men, the day after they were hanged.

At any rate, it will emit fumes of a garlic odour, if sprinkled on a red-hot piece of iron, with some powdered charcoal, or any other inflammable substance; and these fumes will leave white spots on polished copper.* The smallest portions of arsenic produce these effects. There are other modes of discovering it, by chemical tests and analysis,† but I do not know whether they are more to be depended upon, than these I have adduced: they are certainly neither so easy, nor so fit for general use.

But it is not only when taken into the stomach, that arsenic produces its fatal consequences. Worn in amulets, as it was formerly thought a specific against the plague, there are many instances of its having occasioned dreadful diseases, and even death:‡ and used externally, in lotions|| or ointments,

* The best way of trying whether a suspected substance be arsenic, is to place it upon two polished pieces of copper, worn halfpence for instance, and heat them red hot. White corrosion will be observable, if the substance actually was arsenic.

† Arsenic, dissolved in vegetable alkali, added to a solution of vitriolated copper in water, turns it to a beautiful light green. White arsenic added to pure water, impregnated with the air, let loose by pouring sulphuric acid upon alkaliified sulphur, immediately is converted into orpiment, and becomes yellow.

‡ Mead on Poisons.—P. 220, 221. 8vo.

|| *Militis scabiosi decocto arsenici, fese abluentis, genitalium sphacelo,*

ments, and applied in fumes,* it is probably as deleterious, as when swallowed, if it be applied in sufficient quantity. In these cases, it is not easy to detect the cause of death, since the arsenic taken into the circulation by absorption, either suffers some chemical change, or is so minutely divided, as to be imperceptible by any test yet discovered. Nor are the symptoms so appropriate, as to warrant any positive decision concerning their cause. Sickness, convulsions, and vertigo, are symptoms of diseases that do not spring from poisons: nevertheless it must be acknowledged, that their catenation in cases of poison, is very singular; and that the accurate observer, may form a judgment that will be more than probable, although not founded in absolute certainty.

The symptoms produced by the external application of arsenic, are very different from those which follow its reception into the stomach. In the first case, great giddiness, with heat, thirst,

Z 3

quick

cum intolerabilibus doloribus, febre, vigiliis, siti obortis, pessime lueret.

Arfenicalis pulvis cancro mammæ adhibitus, mulierem intra quinq̃ dies crudelissime rapuit. — *Crantz, Mat. Med. T. iii. p. 25.*

* Dum arsenicum repetitis sublimationibus fixare tentabat Tachenius apertis vasis, inspiravit auram suavissimam, sed post *semihorulam* imprudentiæ suæ pœnas luebat. Dum & difficulter spirabat, omnium membrorum convulsiones patiebatur, sanguinem mingebat cum intolerabili ardore, &c. — *Van Swieten, Com. ii. p. 715.*

quick pulse, difficulty of breathing, and anxiety, generally precede any local inflammatory symptoms: in the latter, the most violent symptoms of inflammation are produced, almost as soon as the poison can act on the stomach; and the apparent operation continues local, till near the close. From internal application, *all* the powers of life are attacked at once; the anxiety is extreme, as soon as there is any sickness or pain in the stomach: nor is the stomach always one of the first parts affected. Though for the most part, the stomach and bowels are first affected with violent pains, which wander to different parts of the body; an ardent fever rages, with excessive thirst; the secretory organs are excited into stronger action; great heat is felt with all the discharges, which are often bloody, as well as encreased in quantity; when convulsions and delirium close the scene.

In both cases, those who escape from immediate danger, enjoy but a feeble degree of health ever after. They are generally tormented by vesicular eruptions, very difficult to heal, and are frequently attacked by palsy, or by hectic fever.

The effects of arsenic are easily discriminated from those of all the other mineral poisons, except corrosive sublimate. From this poison, the diversity of symptoms is not very great: this diversity, however,

however, it is of consequence to mark. When either of these poisons are found in the stomach or intestines, the inquiry need not proceed farther. The criterion of arsenic, before given, will be sufficient to discriminate it from corrosive sublimate, and, indeed, from every other poison.—No mineral has the smell of garlic, when exposed to heat, unless it contains arsenic. The symptoms produced by arsenic, neither accede so quickly, nor do they discover so active a corrosive cause, as those of sublimate: the vomiting and purging are seldom so bloody, constant, and severe. Arsenic seldom excites salivation; whereas corrosive sublimate most frequently has this effect, at the same time that the jaws, gums, and throat, are swelled to a great degree. When the effects are chronical, palsy is a frequent symptom of both these poisons; but from corrosive sublimate, it is always a general affection, whereas from arsenic, it has been sometimes observed to fix more particularly in the fingers and hands.* It must be observed, that the marks of discrimination are not very striking, indeed so little, as not to be depended upon, solely, in any case. When combined with other circumstances, they may be remembered sometimes with utility, particularly when the patient lingered so long, as to have no chance of finding the remains of the poison, that caused his calamity.

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The

* *Falconer*, in *Mem. Med. Soc. London*.—Vol. ii. p. 224.

The time in which arsenic kills, is varied by numerous circumstances. Age, constitution, habits, and the quantity of the poison taken, all create a diversity, which it is impossible exactly to estimate. If the quantity swallowed be large, the fluid contained in the stomach, at the time of swallowing it, small, and the body in good health, it may destroy in three or four hours: if, on the contrary, it were swallowed with a large quantity of fluid, by a person of infirm health, the fluid would act as a sheath to the stomach, and the weakness of the body, would render the vital principle less capable of destruction, from the violent action to which it was exposed, and, consequently, life might last thirty or forty hours. I have known a healthy adult, die in three hours and a half, after taking an enormous dose of white arsenic; and have been informed, by persons of experience, that it has killed in two hours.* *Wepfer* mentions the case of a boy, who died in the fourth hour.† In general, from the vomiting excited by the acrimony of the poison, and from the excessive heat and insatiable thirst, which compel the patient to drink copiously, death does not take place till after eight, ten, or even twenty or thirty hours, and sometimes two or three days.

From

* *Mary Phillip* died in two hours after swallowing half an ounce of white arsenic, dissolved in water.—A case recorded in many newspapers.

† *Cicut. Aq. Hist.*—C. xxi. sect. 7. p. 356.

From two or three hours and a half, therefore, till the periods before mentioned, may death take place, from what is called the immediate operation of the poison of arsenic.

In all cases of recovery from immediate danger, the health is very infirm, and frequently sinks, at last, under the effects of the poison. When the quantity of arsenic, either swallowed or absorbed, is not sufficient to destroy life by its immediate operation, it oftentimes excites a dangerous chronic disease, that is ultimately fatal: this has been the case too frequently from it, injudiciously administered as a remedy. These disorders frequently assume the appearance of palsy, sometimes of phthisis pulmonalis, and sometimes of universal eruptions, with general debility, and vague, but violent pains.

Arsenic soon shews its virulence, when taken into the body. The heat of the throat immediately follows the swallowing of the poison; and the violent symptoms are seldom more than half an hour before they discover themselves. *Tachenius*, in the instance cited, felt the effects of the fumes, in less than *half an hour*.*

From external application, the operation is not so

* *Semihorula*.

so speedy. Mr. *Sherwin* felt effects from a very small quantity rubbed into his hands, during the course of a night.* Had the quantity been larger, the operation probably would have been greater. At 'all events, a few hours will be sufficient to discover the malignity of this poison, when externally applied;

Arsenic has been taken, in the quantity of a grain, without any lasting bad effect. Mr. *Sherwin* swallowed half a grain, dissolved in half an ounce of water, without remarking any effect. But to these doses of the white oxyd, small as they appear, objection must be made. No one can assert, that even these small quantities may be universally administered without danger, especially if repeated.

Of the degrees of virulence of the different preparations of arsenic, our knowledge is far from complete. Of the sulphurated arsenics, orpiment is the most thoroughly saturated, and has been given to the quantity of a drachm, without injury:† but when not entirely neutralised by sulphur, it has sometimes proved fatal. The red arsenic, or realgar, is composed of about two parts
of

* Mem. Med. Soc. London. — Vol. ii. p. 397.

† Hensk de Veneris. — P. 276.

Hoffman Pathol. General. — Par. ii. c. 2. sect. 13.

of sulphur, and nine of arsenic, and forms a poison little less virulent than the regulus of arsenic, or arsenic reduced to its metallic form. The acid of arsenic, uncombined, is probably more virulent than any of its combinations: the white oxyd is next to it. With acids, arsenic loses little of its malignity; but with any of them it is combined with difficulty. With alkalies, it becomes to a certain degree, milder, but not to such a degree as to warrant its more liberal use in this form. *None* of the preparations before mentioned, can be taken in larger quantity than a grain or two, without danger, orpiment only excepted; and some fatal accidents which have followed the taking of this preparation, in a few grains, render it a proper object of vigilance and suspicion.*

The following scale is not offered as exact. It will give a comparative view of the supposed virulence of the different preparations of arsenic, reckoning the most extreme degree ten. As arsenic is soluble in about eighty times its own bulk of water, any of the following preparations may be so given.

A. Pure

* For some evil effects of orpiment, as well as the easy mode of uncombining it, see Boyle's Works, by Shaw.—Vol. iii. p. 537, &c.—Common salt, he says, makes it deleterious.

1. Pure arsenic acid — 10
2. White oxyd of arsenic — 9.
3. Acids, with arsenic — 9.
4. Alkalised arsenic — 8.
5. Regulus of arsenic — 7.
6. Red sulphurated arsenic, or realgar — 6.
7. Yellow ditto, or orpiment — 1.

There is no attempt here to discriminate the different degrees of activity of the acids, though such difference undoubtedly exists. And the virulence of the different compounds is estimated upon the supposition, that the quantity of pure acid joined with them, is equal throughout. The quantities of each must be supposed different; for if there are ten grains of pure acid in all, there will, of course, be a surplus in quantity in each, in proportion to its acid, alkali, sulphur, &c. Six is to be understood as a degree of great activity, and fatal in the quantity of a few grains.

Of the mode in which arsenic operates, there are two theories. The one is, that its deleterious properties are owing to the action of its sharp spicula, on the stomach: the other, that it has a peculiar action on the nervous system. Both these theories may contain, perhaps, some truth; but neither of them are true to the extent meant to be inculcated.

That

That arsenic acts with great stimulating and corrosive power, upon the stomach, is certain; but this is by no means all. Supposing spicula to be as sharp as their nature will admit, their most extreme sharpness will not account for the short time in which death takes place: was the stomach torn to pieces, life would not be extinguished in four or eight hours, as it often is from arsenic.

Of the operation of arsenic, or, indeed, of any other power on the nerves, nothing is known. That it acts upon them, as well as on the other constituent parts of the stomach, may be readily conceived; but there is certainly no reason for giving them the exclusive privilege of being injured: the fact is, that the *supposed* action of the nervous system, is the most specious cloak ever invented by medical ignorance. It saves the physiologist the trouble of inquiring, and the physician the labour of acting:—we know not what it is, and we therefore ascribe all the unaccountable and unfounded operations of the body, to its influence.

A fair induction from the appearances of the body, and the analogy of these appearances to those in some other cases of sudden death, will afford us a better clue by which to conduct our inquiry, than any hypothesis, however splendidly adorned, and however ingeniously defended.

That

That the action of arsenic is, in the first place, violently stimulating, whether internally or externally applied, cannot be doubted: it gives the sensation of heat to the tongue, without being swallowed; and rubbed upon the arm, or the face, it excites redness and heat: when swallowed, the appearances of inflammation extend as far as it has reached. After death, putrefaction commences in a much shorter time, than from any of those common diseases, which are the usual avenues to the grave.

From most of the poisons, of whatever kind, from some of the diseases which occasionally spread devastation over the earth, the case is the same. Animals destroyed by vegetable poisons, persons who die of the plague, and the more malignant species of typhus, become putrid in a very short time. Life is extinguished, after a short and violent struggle, so completely, that the component parts of the body are disunited, and melt down into their original particles. In some instances, this is done without pain; life is even dismissed from the body without a struggle: in others, the conflict is more laborious. — *Lauro-cerasus* contains a power, that will extinguish animal life in the former way; arsenic, in the latter, on account of its corrosive qualities. It is not, however, in my opinion, unfair to infer, that death, in all these cases,

cases, has the same general cause, from a principle which acts on the body, as it is compounded of various materials; and by its operation on some one or other of these, so deranges the whole, as to render it incapable of retaining life.

Various powers, capable of destroying life, may be possessed of different properties, besides the essential one; and these properties will account for the diversity in the modes of death, from the various poisons. The corrosive qualities of arsenic, account for the pain and inflammation it excites, while abstracting the vital principle. Lauro-ceratus has no such power, and therefore it destroys without pain or inflammation. The poison that produces the plague, has killed persons instantaneously; its more general term of operation, is two or three days, and the symptoms it produces are various, according to this term. But in all these cases, there is something in the mode of destruction which obviously points out the same general cause;* not as acting merely upon the nerves,
nor

* *Thucydides* observes, that as the plague of Athens first broke out in the Piræus, it was suspected, "that the Peloponnesians had thrown poison into the wells." The violence of the symptoms, as described by the same author, is in many respects similar to that of the stimulating poisons, and gives a colour to the opinion. — "They were seized with burning heats in the head, bloodshot redness of the eyes, and violent inflammation; the tongue and oesophagus, in the greater part of the patients, were distended

as acting merely upon the blood; but as disuniting the component parts of the whole body in some manner, so as to produce death in a very short time. — What this cause is, we cannot explain, because we know not how life is joined with the body, in all cases. — Upon this subject I can only advance some obscure suggestions.

Do not poisons act upon the muscular fibres, as well as upon the blood and the nerves? Does not the motion and powers of these fibres, depend upon their union with oxygene, taken into the body by respiration, and diffused by the circulation of the blood? Does not the action of poisons consist in disuniting the oxygene from these fibres so rapidly, as to extinguish their vitality, before they can have a fresh supply? The sudden extinction of life, in all cases in which the blood is deprived of oxygene,* and the immediate succession of putrefaction, entitle me to make these suggestions; and give some colour to an opinion, which an enlightened and reformed system of physiology will, perhaps, some time or other, satisfactorily explain.

For

ed with blood; with a hiccup that gave them strong spasms and convulsions, &c."

Aretæus remarks this similitude. — *Morb. Acut. lib. i. c. 7.*

Compare *Lucretius*, lib. vi. l. 1143, &c.

* As when animals are exposed to mephitic air, &c.

For attributing the action of arsenic *solely* to the nerves, there is no one shadow of reason: on the contrary, the experiments of *Fontana** prove that poisons have no effect on the body, when applied *solely* to them. Nor have the experiments of *Galvani* or *Volta*, hitherto added much to our knowledge of the nerves: we before knew that they were capable of conveying the stimulations of the will, or of acrid substances, to the muscular fibres; and the experiments with two metals, only afford a more extensive illustration of this important fact, *in some unknown power*,† on whose properties we must pause, till better acquainted with its laws and relations to animal bodies.

Nor can I agree with *Fontana*, in ascribing the action of poisons solely to the change they produce in the properties of the blood. Frogs, it is well known, retain a portion of vitality for many hours after their hearts are cut out; and yet, when they are placed in poisons without their hearts, the remains of life are instantly destroyed. Perhaps it may be urged, on my own grounds, that poisons

A a act

* On the poison of the viper. — Vol. ii. p. 130. 148.

† The similarity between Galvanisation and electricity, is in my mind not yet distinctly proved: the reason for this belief, I derive from the power of ganglions to impede the progress of the animal electricity, as it is called. But it is not my intention to employ my sickle in a field which has already yielded some fruit, and which promises so rich a harvest to the careful and industrious labourer.

act by decomposing the blood, and *thereby* prevent the muscular fibres from receiving that oxygene, which is the pabulum of vitality. But the experiments on animals alluded to before, in which the circulation was destroyed, seem to prove, that vitality may be acted upon by means independent of the circulation, and hence I conjecture, that the muscular fibres of the whole body are affected by some communication which is pervious only to poisons. In some cases, (as from laurel-water, and the miasmata of the plague,) this communication is so instantaneous, as to destroy every portion of life without a struggle: in others, the communication is more slow, and life is destroyed, after a certain interval, unequally, in different parts of the body; hence the convulsions that ensue, are the last efforts of expiring nature, to restore the just balance of the moving powers.

The indications of cure, when arsenic is taken into the body, are two:—to discharge the poison; to correct it, and to shield the stomach and intestines from its acrimony. The first intention seldom can be expected to succeed, when the poison has been long in the stomach, as probably a quantity sufficient to produce the worst effects, will be acting on the general system, before any long time has elapsed. Yet, in all cases, it will be proper

to

to give an emetic, or cathartic, with the view of discharging it, as the effects of the quantity that does act upon the system, may be essentially assisted by any particles of the poison that stick in the folds of the stomach and intestines. When the poison has been taken but a short time, there cannot be any doubt about the attempt to discharge it. This is best done by emetics, and such large quantities of warm fluid, as will excite nausea. The time which ipecacuan takes to operate, is too long for it to be used alone, with any success; recourse, therefore, should be had to the more stimulating emetics. Vitriolated zinc, or tartarised antimony, best answer, in point of quickness of operation, and they may be used in large quantity, without fear: along with them, ipecacuan may be given, as it will continue the irritation begun by the more active emetics, and render the discharge of the poison more certain.*

If the time since which the poison was taken, authorise the suspicion of its having proceeded to the intestines, the stimulating cathartics, such as scammony and calomel, may be given, with warm aqueous liquors, which, in all cases of corrosive poisons, may be used with advantage, as they will

A a 2

not

* As the action of the stomach is generally excited to so great a degree, as to prevent the full discharge of its contents; in those cases, the evacuant medicines will be much assisted by small doses of opium, with copious draughts of an infusion of mustard in warm water.

not only serve to discharge them, but also, by dissolving the poisons, to sheath the alimentary canal from their acrimony. Indeed, from the first moment of suspicion that poison has been swallowed, warm aqueous fluids should not be spared. Upon no medicines can we place greater dependance for sheathing the intestines, than these, which include mucilages of gums, broths, milk, and even warm water: there can hardly be excess in administering them. Oils are not so proper, as they do not dissolve arsenic.

For correcting the poison, all the preparations of sulphur, particularly those that are called liver of sulphur, and the flowers, are peculiarly appropriate; with these, mild alkali* may be given in considerable quantity.

For external application, washes, with the solution of liver of sulphur, and warm baths, impregnated with sulphur and alkali, are useful; particularly when the poison has been long in the habit, and when the virulence of its operation begins to abate. But all these correctives are quite secondary objects; the first care should be to expel the poison from the body, if it be possible, as we cannot

* The baths of Carlsbad, which have been useful in curing arsenical diseases, contain aerated mineral alkali. — *Bergman's Essays*, vol. II. p. 807.

cannot depend upon the success of attempts to correct it.

I do not mean to insinuate, that the correctives should be neglected, far from it; but only to recommend the previous use of those medicines, which will tend to discharge the poison from the body. If the *hepar sulphuris*, and the other preparations of sulphur, can be administered at the same time, it will be well to administer them. But we should never suffer ourselves to be deluded with the hope of correcting the poison, when it is in our power to expel it.

When the poison was applied externally, correctives must be applied with double vigour: but even in this case, the use of diluents should not be neglected. It is not easy to fix so precise a method of cure, as shall be serviceable in all cases. In general, however, when the poison has been swallowed, the plan I have laid down, should be strictly followed: and for external application, the correctives should be tried to their utmost extent, with the moderate use of evacuants and diluents.

When the immediate danger is over, our care should be directed to prevent the train of diseases of debility, that too frequently follows. With

this view bark, nitre, and tonic medicaments, should be administered, according to the nature of the symptoms.

Into so wide a field, the limits of this essay will not suffer me to enter farther; and I shall content myself on this head, with transcribing a case from *De Haen*,* that contains a good and successful method of cure. I do not insert it to recommend the brassica rubra in particular, but as an admirable illustration of the arsenical diseases.

Arsenici albi terribiles recensere juvat effectus. Hortulani in proximo pago *Pensink* uxor, nunquam adhuc gravida, sanissima tamen, ac torosa mulier, mense Julio anni 1763. emerat pro ægro-tante quopiam puero, pulveres duos *Cremoris tartari*, & *Lapidum cancrorum*, eorumque uno puero dato, alterum in mensa reposuerat. Ipsa vero a prandio minus recte se habens, sumpsit, ut putabat, hunc alterum pulverem.

Notandum est feminam hanc, antequam pulverem fumeret, præ enormi siti immaniter aquam gelidam bibisse; prætereaque pulverem una cum ingenti aquæ copia assumpsisse: ita ut copioso cum veneno, antidotum quoque sumpserit copiosum.

Cum

* Ratio Medendi, vol. iii. p. 11, &c.

Cum valida ventris tormina pati inciperet, petiit lectum, nauseavit, elapsa autem semihora vomuit. Interea temporis redux domum maritus, videt uxorem vehementer vomentem, & anxiam esse. Igitur percunctari ille quid gestum, quidve assumptum sit? Dum vero inaudit pulverem hunc, quem in mensa mane se reposuisse uxor ajebat, assumptum ab illa esse, mox territus hic ad mensam accurrere, & miserando ejulatu vociferari, pharmacopæi pulverem in mensa reperiri, ejus vero loco assumptum pulverem *Arsenici albi*, quem ad mures necandos emtum, eadem in mensa incogitanter reposuerat. Vocatus actutum Medicus, oleo & lacte corpus laudabiliter implevit; unde vomitus, qui per multas horas plus centies erupisset, paulatim cessavit.

Porro mirabatur femina quod, vomitu cessante, se tam belle haberet, quemadmodum etiam die altero tertioque. Quarto vero die pedes invasit, qui dicitur *crampus*, crassaque plantarum pedum epidermis tota secessit. Qua dein recrefcente, incedere, præ summa ejusdem teneritudine, dudum non potuit. Jussa est *Badensia* Balnea sulphurea adire, mensisque hisce uti spatio. Catamenia subistere in balneo. Multaque ibidem Medicamenta sumsit. A Balneo crurum ipsi sensim impeditior motus, sic ut primum ingenti cum labore, tardissimeque, passus quosdam ederet, ab ineunte vero

Septembri cruribus movendis ultra non esset; manuumque, ac brachiorum fere omnem motum amitteret; humeris solis, ac femoribus nonnihil adhuc obsequiosis. Jamque universo de corpore, caput si exceperis, epidermis secessit. Postmodum autem motus exiguus musculis manuum rediit, ut sinistro leve quid, chartam v. c. tenere, dextro digito nonnihil, sed obscure, ut vix advertisses, movere posset. Binis vero hominibus suffulta, crura ne hilum quidem movere potuit. Quodque in paralyticis nonnunquam adverteramus, ut jacentes artuum inferiorum superiorumque motum quemdam, qui sedentibus istis impossibilis, ederent; hæc ne vel minimum quidem. Attraxit utcunque crus, & brachium, levi illo motu, quem dixi humeris femoribusque superflitem fuisse, haud vero movit. Intolerabilis accessit crurum, pedumque, pruritus, qui in aliis boni sæpe auguri, in hac vero minime. Interea pulsus, appetitus, somnus, alvus, urina, bona; quique in balneo substiterant, rediere menses. Multis, iisque præstantissimis remediis incassum usa, inducta demum in Nosocomium nostrum est, ineunte Novembri anni 1763.

Datis, ut monui, incassum selectissimis remediis, animum mihi subiit vires explorare, cum aliis vulnerariis, *Brassica*, cui *Otto Tachenius*, vapore *Arsenici* captus, curationem suam magnam partem adscripsit, postquam lacte & oleo a præsentis periculo vindicatus

dicatus primum esset; in *Hipp. Chem. Cap. XXIV.* fumpfit itaque femina bimestri spatio hoc decoctum: R. Tarax. rec. cum toto unc. v. Brassicæ rubræ Lib. j. Pulv. Sarsap. unc. ij. Glycyrrhi. unc. iij. coq. aq. p. per horam. Colat. Mens. j. v. D. u.

Cardialgia ex acore manifesto vexata aliquoties fuit, sed mox restituta usu misturæ, paratæ ex aqua sambuci, fyr. diacod. & lap. cancr. Semel autem febris, cardialgiam concomitans, remedio huic haud obediuit amplius, sed cephalalgiam adjunxit, & tantillum illud, quod superat, motus, prostravit. Cogebamur tunc cortice peruviano eandem fugare; haud multo tamen; cum paucos intra dies febris, suis cum symptomatibus, fusa, fugataque esset.

Spatio bimestri hac methodo Paralyfin, ac pruritum, doloremque nihil emendavimus. Unde robur nervis cortice peruviano conciliare annitebamur, interea dum crura manusque nunc aqua vulneraria, nunc pulveris aromatici fumo, bis die fricarentur. Vis dein electrica, quotidie semel adhibita, levem quidem emendationem fecit, ut crura utcunque plus attrahere, ac digitorum manus spectabiliorem, pedisque dextri obscurum, qui nullus fuerat, motum edere posset; at vero tandem corpore ad lecti crepidinem suffulto, crura ac pedes immisimus in balneum, usque supra genua, aquæ calidæ,

calidæ, cui flores chamomillæ, flores sambuci ac lavendulæ intabuerant: dum interea corpus repletur decocto Tarax. Nasturt. Sarap. Glycyrrh. Effectum hinc, ut decurso mensis horum in usu spatio, gradi inciperet, cum iisdem deinceps pergendo ambularet, digitos nendo exercebat, ac tandem mense Junio domum, quo aere rusticano frue retur, peteret, & sæpius inde ad me pedes venerit; ob reliquias mali ejusdem remedii novam formulam petitura.

Quæri a me posset citiusne curata hæc femina fuisset, quando, vel antequam meæ curæ subjiceretur, vel saltem cum eidem subiecta esset, ultima meæ methodi parte tractata fuisset: indicante nimirum pruritu illo dolorifico ac redinem, aut veneni residuam, aut veneno genitam, ante ostia cutanea morantem, suique per eadem expulsionem flagitantem? Ægre sane quæstionem hanc non fero. Inui brassicæ vires, *Tachenio* autore, me explorare voluisse, viresque deinde electricas. His scopo non respondentibus indicationem, de qua quæstio agit, secutus sum; in simili postmodum offerendo mihi casu ab ultima indicatione incepturus curam, quo constare posset num & citra auxilia diluentia, saponacea, ac solventia, aut venenum aut veneno genita materies, æque feliciter expelli posset. Interim haud displicuisse lectoribus opinor, hanc integram communicando historiam, qua non curam duntaxat, sed

sed una contueantur mirabundos *Arsenici albi* effectus. Quod ipsum copia enormi, scrupuli certe pondere graviore, assumtum, primum quidem abundantissima, quam tam mox ante, quam una cum illo sumserat, aqua; deinde vero saluberrimo consilio medici præstantis oleo & lacte, sic viribus inerme redditum est, ut neque necaverit feminam, neque hospitatum diu in primis viis fuerit, sed his cæterisque relictis extremorum artuum Paralyfin, epidermidis universæ secessum, perpetuumque cutis pruritum, dolentemque eundem, generaverit.

For this quotation, long as it is, there is no necessity for apology; since it is written by a physician celebrated for his perspicuity and accuracy, and serves to illustrate the chain of symptoms arising from arsenic, and their cure.

We proceed next to the mercurial poisons.*

2. MERCURY.

* Mercury was not known to the ancients as a poison, although it was so much suspected, that *Galen* was afraid to use it as a remedy. The era of its first discovery, was probably that of the first commerce with Spain, a country which abounds with this mineral, and which *Horace* characterises as fruitful in poisons.

Atque Iberia

Ferax Venenorum.

Epod. v. 22.

We may judge what they knew, and what they thought of mercury, by the following quotations.

Sed

2. MERCURY.

IN its crude, or fluid state, mercury is inert: it becomes active only by combination.

Of its active preparations, the powers are various; some of them being most virulently poisonous, whilst others are nearly innoxious.

To the first class, belongs the corrosive sublimate, or mercury combined with oxygenated muriatic acid, and, at some distance in point of virulence, the preparations of mercury with nitrous acid, called red precipitate, &c. &c.—To the second,

Sed ferro, lapideque ignito, ea quæ per erosionem interimunt medicamenta, similia sunt, ad hæc Arsenicum Hydrargyrus. — Galen de Simpl. Med. fac. lib. iv. c. 19.

Hydrargyrus non est a sponte nascentibus medicamentis, nullum autem ejus feci periculum, nec quod interimat si devoretur, neque ubi foris admotus sit. — Galen in eod. lib. ix. c. 71.

Hydrargyrus — potum vim perniciousalem habet, suo enim pondere interna exest. — Dioscorides, lib. v. c. 60.

Argentum vivum, eadem quæ spuma argenti inducit. — Paul Aegineta, de Re Med. lib. v. c. 63.

The plain inference is, that they knew nothing of the matter. *Galen* confesses he never tried it, and *Dioscorides* attributes effects to it, which never take place from the crude mineral. Its astonishing powers were discovered, by the absurd attempts of the alchemists.

For an history of mercury and its preparations, vid. *Lhrman Diss. in Sandifort Thesaur.* vol i. p. 541.

cond, all the other preparations, placing vitriolated mercury, and calomel, at their head.

Corrosive sublimate,* is a sure poison from two to six grains; and even in the quantity of half a grain, it has been known to produce very alarming effects. When taken internally, its operation, in many respects, is similar to that of arsenic: the same heat and corrosion are felt in the œsophagus,† but probably in a greater degree: these are succeeded by excessive pain of the stomach, thirst, and sickness. Purging, as well as vomiting, and often of blood, is a more usual consequence of corrosive sublimate, than of arsenic, and is, therefore, one of those slight marks of distinction to be attended to. A profuse flow of saliva, and swellings of all the internal parts of the mouth, afflict the patient, who is tormented at the same time with great anxiety, trembling of the whole body, and difficulty of breathing: to these succeed the convulsions,

* *Mead* is very unsatisfactory in his account of this poison, for as soon as he has quoted one instance of its effects on a dog, from *Wegfer*, he flies off in a very desultory inquiry, how, from ingredients singly innocent, so mischievous a compound can result. — *Mead on Poisons*, p. 191.

† *Erosionis sensus in œsophago*. — *Lieutaud Hist.* vol. i. p. 33.

Magnam ille rofionem in œsophago statim perſentit. — *Boneti Anat. Præd.* lib. iii. obf. 4.

Many cases of the effects of corrosive sublimate, may be seen in *Morgagni de sed. & caus. liz.*

convulsions, cold sweats, &c. which attend almost all acute diseases at their close.

On dissection, every part of the œsophagus, stomach, and intestines, touched by the poison, is found corroded, inflamed, and mortified. The corrosive power is greater than that of arsenic, consequently the mischief done is more apparent. If the corrosive sublimate has proceeded to the small intestines in any quantity, the parts below it, will be found contracted so as almost to shut up the passage of the intestine: this has been the case likewise with the œsophagus, when the poison has been attempted to be swallowed undissolved.*

Corrosive sublimate is as deleterious when used externally in lotions, unguents, or powders, as when swallowed. The symptoms are nearly the same, as when it is taken internally.

† “A woman, to whom corrosive sublimate was externally applied, in the form of a plaster, was seized with intolerable pains, vomiting, convulsions,

* A young woman endeavoured to swallow two drachms of corrosive sublimate, undissolved in any fluid; but from the extreme irritation of the poison, the œsophagus so closely contracted, as to prevent its passage into the stomach. She did not confess what was the cause of her calamity, till several hours after she had taken the corrosive sublimate; and died on the sixth day of a mortification of the throat.

† *Plenck de Venenis*, p. 263.

fions, swelling of the jaws, and salivation, and died in great agonies."

* "A strong robust woman, aged forty-nine, had an ulcerated cancer of the breast, on account of which she consulted an empyric. After being prepared during fifteen days by bleeding, purging, and domestic baths, the empyric proceeded to the use of a white powder, which consisted of corrosive sublimate. The pains began soon after the application, but encreased, and at the expiration of four hours became intolerable. All at one time she was attacked with anxiety, nausea, vomiting, even of blood, convulsions, and at last she suffered the most dreadful tortures in every part of her body, from which she was not delivered by death, till the next morning. On dissection, no other disorder was apparent, than an effusion of reddish serum, with which the chest was nearly filled."

These melancholy instances of the abuse of corrosive sublimate externally applied, will spare me the task of enumerating the symptoms at greater length; nor indeed have I any thing more to add to this part of the subject, than that the term of action will be deferred by this mode of application, and that a larger quantity of the poison will be necessary

* *Pibrac sur l'usage du sublime corrosif, in Mem. Acad. R. de Chirurg, tom. xi. p. 245.*

necessary to produce fatal effects, than when it is directly taken into the stomach. When the quantity applied to the system is not sufficient to produce immediate death, or when fatal consequences have been prevented by the administration of remedies, the evil does not always stop: a long train of diseases are known to follow its improper and incautious use; and phthisis or palsy terminates life.

The quantity of corrosive sublimate that may prove deleterious, is much the same as that of arsenic;—from two to six or ten grains. It is administered as a medicine, to the quantity of a quarter and half a grain for a dose, and I believe frequently with advantage: but too much caution cannot be urged, to guard against *misuse*. Indeed in this case, it would be well if the authority of the laws were enforced to check an evil, the extent of which cannot be seen. It ought not to be in the power of any unqualified persons, to dispose of medicines which may be administered with such facility, and which destroy life with so much certainty, without the signature and authority of those, who alone are authorised to dispense them*.

Corrosive

* And even they will do well to have in mind the solemn advice of the great father of their art.—“ I will never administer to any person any poison; no, nor if intreated, any thing of a poisonous or destructive nature—Nor will I assist in any such consultation or prescription.” *Hippocratis Jusiurand.*

Corrosive sublimate does not destroy life so quickly as arsenic, though, perhaps, in the average number of cases, there is no great difference. There are no instances upon record, in which its operation was so short as three or four hours. From ten hours, to thirty or forty, will be the more common term of operation.

The operation of corrosive sublimate seems so remarkably analogous to that of arsenic, that what I have said on that head, will be perfectly relevant to this. If we make any discrimination, it is, that the corrosive power of arsenic, is less than that of corrosive sublimate, and that the virulent qualities, in which its power as a poison more especially resides, are greater: hence the operation of corrosive sublimate is not so quick. This difference in the term of action, and its distinctive operation as a mercurial, are the only marks by which the one poison can be known from the other.

Of the action of the mercurials in particular, I can speak with little confidence. I believe, that in a certain degree, it diminishes the powers of sensibility and life, but whether from an excess of stimulation, is not easily determined. The mercurial medicines promote excretion and secretion, and have a particular effect on the salivary glands, which is the distinctive operation alluded to.

All the authors on this subject, mention the salivation as one of the most remarkable symptoms of corrosive sublimate; and one of them goes so far as to say, it was so certain, that he could renew it at pleasure.*

Corrosive sublimate, found in the stomach, may be discriminated from arsenic, by not giving out the garlic odour when placed on hot coals. For any of the other mineral poisons it can hardly be mistaken. If a grain of corrosive sublimate be added to a solution of mineral alkali, in pure water, a red powder will be precipitated.† Aerated, or common magnesia, will slowly precipitate corrosive sublimate, from solution in water, as a darkish red powder: pure, or burnt magnesia, as a black powder.‡ These chemical tests will be sufficient to distinguish this poison, though it be found only in the quantity of a grain or two in the stomach; and I have mentioned them, as they may be easily tried by any person.

The

* Il produit souvent une salivation impetueuse sans qu' aucun d'eux soit garant qu' elle puisse etre moderee par l'art. — La salivation renouvella a mon gre. — *Pibrac*, in *Mem. Acad. R. de Chir.* xi. 249.

† *Bergman* on Aerial Acid, sect. xxi.

‡ *Black*, on Magnesia Alba.

The cure of those poisoned by corrosive sublimate, must be undertaken with much the same intentions, as if it happened by arsenic: but here we may place greater reliance on correctives.

The indications of cure are:—

1. To discharge or correct the poison.
2. To shield the stomach and intestines from its acrimony.

I have so strongly insisted before on the use of large quantities of aqueous and mucilaginous liquors, when arsenic is suspected, or known to be taken into the stomach, that I shall say no more on this head, than that they are as necessary, and in the largest quantities, when corrosive sublimate has been swallowed. They not only answer the first intention, by contributing to discharge the poison, but they also sheath the stomach and intestines, at the same time. It may be thought unnecessary to give emetics or evacuates of any sort, in cases where corrosive sublimate has been taken, on account of the violently stimulating properties of the poison itself, and that we have only to assist the discharge, by the profuse administration of liquids. But the fact is, that we must never suffer poisons to take their own course. Our first endea-

your should be to discharge them, especially soon after they were taken; and for this purpose we should use the most vigorous means. Emetics of vitriolated zinc, on account of the suddenness of their operation, are well calculated, in the first place, to answer this intention: in the second, recourse must be had to correctives, and their use should be persisted in with confidence and vigour.

As corrosive sublimate consists of mercury, combined in a peculiar manner with muriatic acid, and as its poisonous qualities result from the combination, all the means that tend to disunite them, will most essentially serve for correctives: and they may be uncombined by the addition of any of those substances which have a greater elective attraction for one or other of the component parts, than they have for each other. The alkalies answer this end, by attracting the muriatic acid, and leaving the mercury free.

Of the alkalies, the vegetable has the superior attraction for muriatic acid, it is best, therefore, for this purpose: next to it comes the mineral alkali. With diluting drinks, such as broths, milk, gruel, &c. &c. one or other of these should be poured into the stomach, and we need not fear to give them in a very considerable quantity.*

I shall

* A boy swallowed an ounce of corrosive sublimate, and had all the
bad

I shall not enter into any farther detail, with respect to the method of cure, of which the case below* will serve as a good practical illustration: nor shall I attempt to enumerate, much less to describe, all the diseases which are said to supervene, when life is not immediately destroyed by corrosive sublimate. The general similitude of this poison to arsenic, has induced me to refer a great deal of what might have been said concerning it, to what has been already mentioned under that head: where any difference appeared to exist, I have endeavoured to note it.

Nitrated Mercury is so corrosive, as to consume

B b 3

all

bad symptoms; yet recovered by the judicious use of vegetable alkali.—
Com. Norimb. 1735. Hebd. xxx. sect. 3.

* Innupta quædam sæmina 40 fere annos nata, voravit mercurii sublimati corrosivi integram drachinam. Illic correpta est necessariis symptomatibus, calore nempe & cruciatu summo ventriculi & intestinorum. Pharmacopæus qui brevi post adfuit, aquam tepidam atque oleum lini copiosissime in gulam ejus ingessit, ut veneni partem educeret ventriculo, ant saltem dilueret atque obtunderet. Post horas aliquot ad ægram ego sum accersitus. Haustum præscripsi sexta quaque hora sumendum, qui olei amygdalarum dulcium atque aquæ alexeteriæ simplicis singulorum unciam unam, cum mannæ drachmis tribus habebat: cui post tres horas, perpetuo interponendum erat enema ex olei amygdalarum dulcium tepesacti unciis quinque. Tum idoneis intervallis præcepi in jusculum ovinum, ut copiose instillaretur lixivium tartari, atque ita frequenter epotaretur fore enim speravi ut sal illud alcalinum cum mercurio corrosivo in intestinis commissum salia ejus acida ad se arriperet, et mercurium crudum & fere innocuum redderet. Quod ex sententia successit. Postquam enim per duodecim dies in hoc regimine persistisset, ab omni dolore & periculo liberata est. — *Akenfide de Dysenteria*, p. 43.

all animal substances it touches, though applied to them in the smallest quantity. On the skin, it produces purple spots, which form scales, and fall off; if it is not exhausted by this operation, it goes on consuming the texture of the part, till it is all decomposed by the process of corrosion and consumption.

Taken into the stomach, all the preparations of nitrated mercury are capable of destroying life, when they are applied in sufficient quantity, as they are capable of destroying the organization of the part. The symptoms they produce, are those of most violent active inflammation;* excessive pain and sickness in the stomach, with dreadful spasmodic affections of that and the neighbouring parts, and frequently bloody discharges by stool, as well as vomiting. This inflammation proceeds to mortification, when faintness, hiccup, anxiety, and cold sweats come on, with convulsions. — Salivation is a characteristic symptom of all the mercurial poisons, and occurs more or less when any of them have been taken to excess.†

On

* The inflammation from a corrosive, or from the common exciting causes, cold, &c. will be different, inasmuch as the exciting cause is more violent, and is continually acting, till it destroys even the texture of the organ. Hence the pain will be more severe, and the efforts to cast off the exciting cause will be greater.

† *Fœminam ab assumpto mercurii præcipitato quem empiricus aliquot diebus*

On dissection, the stomach, and all the parts touched by the poison, will be found inflamed and mortified, and some of them corroded. Strictures sometimes are formed in the parts below the poison, owing to its violent stimulations.

Externally applied, the danger is not the same, as it must be used, to produce any very alarming consequences, in so large quantity, as to give sufficient warning to the patient: yet may it be applied to some organs, so as to render life of little value, though it may not endanger its continuance. A small portion will destroy an eye, or make such apertures and wounds in other parts, as to leave little comfort ever after. I have seen, more than once, very troublesome inflammations of the absorbent vessels of the leg and thigh, with a chain of abscesses along their course, arise from its application to sores of the leg.*

B b 4

Notwith-

diebus ad sex gr. cum paucis potu obtulit, horrendis spasmodis fuisse affectam & tandem mortuam. Sectione facta multæ rubræ maculæ in fundo ventriculi, duodeno & jejunis repertæ fuerunt; ventriculus tumefactus, portio vero jejuni artissime constricta fuit. — *Hoffman* de *insec. Med.* tom. vi. p. 313.

* Ce médicament (Principite rouge) causa un flux très considérable de bouche. Les commissaires disoient, que ce fait n'étoit pas nouveau, & qu'il devoit servir à rendre les Chirurgiens circonspectes dans l'application des remèdes topiques dont quelques uns peuvent être très nuisibles & dangereux. — *Mem. Acad. R. de Chir.* xi, p. 249. — *Vide Hildani Obs. Chir. Cent. v. Obs. 94.*

Notwithstanding its corrosive qualities, nitrated mercury has been given internally, in small doses; but seldom without pain and uneasiness. In the quantity of two or three grains, the mucus of the stomach may envelope it, and resist its acrimony; but even in this quantity it is to be feared. From six grains, in the case cited before, death was produced. The circumstances of the stomach at the moment, and whether fluids were taken with it or not, will very materially alter the case. If the stomach be empty at the time, and little or no fluid be given with it, bad consequences are much more likely to ensue.

We have no data upon which to ground our determination, in what time nitrated mercury will produce its effects. Inflammations of the stomach have been known to terminate in death in eighteen hours* from their first appearance. From this time, therefore, to three or four days, we may conclude will be the general average.

If nitrated mercury be found in the stomach, it may be discoverable by precipitants; but its forms will be various, according to the modes of the solution.† The existence of the nitrous acid is always discoverable,

* *De Haen de possibili termin Inflamm.*

† *Bergman on the Analysis of Waters, vol. i. p. 133.*

discoverable, by the substances in which it is an ingredient, giving out red fumes, when exposed to heat. From corrosive sublimate it may be distinguished, as mineral alkali will precipitate it, in the form of white clouds. From nitrated silver, by mixing it with a solution of sea salt, which will cause a small precipitation from nitrated mercury, but a most copious one from nitrated silver. From arsenic, the garlic smell of the fumes will distinguish it, and, indeed, the duration of the symptoms. From the other poisons, the discriminations will be marked under their different heads,

The operation of nitrated mercury, is probably the same as that of all the other corrosives, that have no other specifically poisonous quality. They all act on a principle similar to that of combustion. It is now tolerably well ascertained, that the phenomena of inflammation and combustion, arise from the decomposition of a part of the atmosphere, which was termed by its discoverers, dephlogisticated, or vital air, but which modern chemists have agreed to call oxygenous air. During this process, the different component parts of the oxygenous gas, are let loose, some of them in the form of light and heat, while others are combined with the base of the substance burnt. Infinite are the

the varieties of combination, from the modes and the substances employed. In some, the oxygene is firmly united to its base, and is separated from it with very great difficulty: with others, it is so loosely connected, as to give itself out upon the first application of any substance having a stronger attraction for it. This is the case with the corrosive poisons. The oxygene they contain, has a much more feeble attraction for them, than it has for animal matters: hence, when the latter are applied, it is poured into them with such amazing velocity, that an actual combustion, and consequent decomposition of parts, takes place, organization is destroyed, and the vitality of the whole body suffers, in proportion to the importance of the functions of the impaired organ.

For the cure of those poisoned by nitrated mercury, we must have recourse to nearly the same means recommended in the case of corrosive sublimate. The poison should be diluted with very copious draughts of mucilaginous and aqueous liquors, and then discharged by the operation of an active emetic, such as vitriolated zinc. Alkalies may be used, with great advantage, as correctives, indeed, they are sovereign remedies in this respect, when an acid forms part of the noxious compound.

Preparations

Preparations of sulphur may also be serviceable, when alkalies are not at hand, but they are never to be relied upon solely. — Calcined magnesia has been recommended, and is an useful medicine in these cases, chiefly to be employed, when the poison is supposed to have reached the intestines, but never ought to make us undervalue the alkalies, or be suffered to supersede them. After the immediate danger of the poison is past, great debility of the organ affected, frequently remains: this must be remedied cautiously, by stimulants administered gradually, and in proportion to the strength of the patient. No better rule of practice can be given, than that which is usually followed in the decline of active inflammation. When the inflammatory symptoms are entirely abated to apply such moderate stimulants, as shall prevent the other extreme, an entire loss of action.

Vitriolated Mercury, or turbith mineral, is a most active emetic and cathartic, in the quantity of seven or eight grains. From the other mercurials, and from arsenic, it will be distinguishable, as not possessing their corrosive qualities. If however, it be taken in the quantity of a scruple, and from that to a drachm, it will produce violent pain of the bowels and stomach, with incessant vomiting and purging, which, if not soon remedied by diluents

luents and alkalies, will be followed by inflammation, mortification, and death.*

Calomel, mercurius dulcis, and some other preparations of mercury, are active also, in doses of four or five grains, and have been known to produce very terrible consequences when they were taken to the quantity of a drachm, and in some cases, of a few more grains than usual.

“ A healthy boy, fifteen years old, took fifteen grains of mercurius dulcis, well prepared: immediate vomiting followed, with anxiety, restlessness, and tremors of the feet and hands, and finally, with a contraction of the hands. He died on the 6th day.”†

“ To a boy of twelve years old, fifteen grains of mercurius dulcis were given for a dose. Anxiety, a vomiting of black matter, and death, were the consequence.”‡

“ One who took by accident half an ounce of mercurius dulcis, died within twenty-four hours. ||

These

* Helvigijs a Turpetho minerali tormina, & anxietates speçavit.—Hoffman, tom. vi. ex—Miscel. Nat. curios. Dec. 3. an. 8. obf. 7.

† Hoffman de infec. Med. tom. vi. p. 314.

‡ Ibid.

|| Hoffman ex Miscel. Nat. cur. Dec. 2. an. 10. p. 20.

These cases serve to illustrate the symptoms, and the quantity of the poison which will produce them;* and we may judge, that they would be nearly the same from vitriolated mercury, as from mercurius dulcis. In one case, life was terminated in twenty-four hours; from this time, therefore, to three, five, or seven days, may existence be prolonged.

In all cases, the stomach will be found inflamed and mortified, but not corroded by the mercury. When there are corrosions from a mercurial, corrosive sublimate, or nitrated mercury, should always be suspected.

The actions of these preparations of mercury can easily be explained, by supposing that their stimulating properties produce inflammation of the stomach, which is too apt to proceed to gangrene. There may exist some noxious operation, peculiar to them as mercurials; but however this may be, their other powers will be sufficient to account for the evils they produce.

The cure, must be attempted by diluents, very copiously administered, by discharging the noxious substance by emetics of vitriolated zinc, and by the use of alkalies, and preparations of sulphur.—

There

* Mäuger's Bibl. Med. Præc. lib. xxiii. p. 825.

There is little variety in the general rules of cure, in all the cases of mineral poison: much must be always left to the particular exigency of the case, and to the good sense of the practitioner.

Mercury is not only hurtful in these more compounded states, but is capable of being extremely deleterious, when combined in the most simple way with the pure part of the atmosphere, and applied in the form of fume to the bodies of animals.

“*Fallopius*, de metallis & fossilibus, affirmis, that few of the workmen live more than three years in quicksilver mines: and *Etmuller*, in his mineralogy, that they are seized with tremors, palsies, and vertigos, in the course of four months. In the transactions of the Royal Society of London, a letter from Venice informs us, that none of the workmen in the quicksilver mines in the Forum Julii, are able to labour more than six hours at a time. One of the workmen in these mines was so impregnated with quicksilver, that if he handled brass, or put it into his mouth, it became white. *L. Tozcius* observes, that the workers in quicksilver are apt to be troubled with asthma, and their teeth fall out.”*—In the town of Birmingham, I have had many opportunities of observing the diseases of gilders, which arise from quicksilver; and I am likewise

* *Rezzarini de Morb. Artificum. c. 1.*

likewise indebted to Dr. *Edward Johnstone*, of that town, for much information on the same subject.

The process of gilding, consists chiefly in the amalgamation of gold by mercury, in placing this amalgam on the metal to be gilded, and then, in separating the mercury from the gold, by heat, and thus leaving the metal roughly gilt. It is in this last process, the evaporation of the mercury, that the workman is liable to injury. Hence, if his body be exposed to the fumes of the metal, either by a current of air, by chance, or by negligence, he is sure to suffer.

All those who are engaged in any other processes of mercury, with heat, are equally exposed to the bad consequences; as mercury rises in vapour, or boils, at the 600 degree of *Fahrenheit's* thermometer.

The most usual symptoms of this mercurial disease, are, first of all, languor and lassitude, with pain of the head, dimness of sight, nausea, and acidity of the stomach, and vomiting, which generally affords much relief; sometimes pains of the bowels, and costiveness, followed by diarrhoea, which, like the vomiting, is for the most part serviceable, and often entirely carries off the disease. But if the patient still continues his employment,
and

and more particularly, if he is intemperate in drink, or debilitated by depressing passions, or any other cause, these symptoms are likely to return in an aggravated degree. He is attacked by aching pains in every part of his body, with agitation and tremors of the hands, at first slight, but gradually encreasing, and extending to the arms, neck, and face, and so to the whole body, and which become at last so violent, as to prevent the ordinary exertions of the voluntary muscles. In some cases, the muscles of respiration are so much affected, as to produce anxiety, with great oppression of the breast: the pulse is generally weak and low: the intestines are affected with spasms, attended by costiveness, which often encreases to obstinate constipation: the extremities are cold, and the whole body exhibits symptoms of failure of the powers of life. The teeth are commonly loosened; and salivation comes on, which, though a frequent attendant of the disease, is by no means regular in its accession, as it full as often precedes, as follows the paralytic symptoms. If occasioned by a sudden *blush* of the vapour upon the operator, its accession is immediate; but in such cases, the shaking, and other paralytic symptoms, have not been observed.

When the disease ends fatally, its terminations are various: sometimes by palsy, and sudden death;

death; at others, by constant and insuperable diarrhœa. Frequently is life terminated by dropfical effusions in the different cavities of the body; and now and then by a fever, most resembling typhus, from which, if the patient recover, the recovery of his strength is remarkably slow, though the paralytic symptoms soon disappear.

Beside the above, gilders are often subject to asthmatic and phthical complaints, which seem to depend on the loss of action of the parts concerned in respiration, not on inflammation or ulceration.—Women are not so liable to be affected by these disorders as men; and those of the sanguine temperament, and who are inclined to corpulency, are less liable than lean, weak, and irritable persons: but of all, the nasty and intemperate, are most subject to them.

Mercury, when applied externally, in the form of ointment, has never, as far as I know, produced the dreadful disease before described.—I have known two drachms rubbed into the thighs, every night, for a fortnight, and no bad effects followed, not even salivation. Dr. Gregory used to relate the case of a gentleman in his lectures, who rubbed in an ounce of mercurial ointment daily; he was not salivated, but much oppressed.—There seems, therefore, to be a remarkable difference in the
Cc operation

operation of mercury, when it is applied by fume to the body, and when its particles are absorbed, after being rubbed down by simple triture. The combination with oxygene in large quantity, in the form of fume, is probably the cause of the difference. Mercury, by this combination, becomes more poisonous, as in the case of its addition to the oxygenated muriatic acid, and according to the mode and the circumstances of its application, equally capable of abstracting the vital principle.

The fumes of mercury have been known to kill instantaneously. From the circumstances of their operation however, their effects are generally chronic: as the operator is not always exposed to them, the disease is gradually introduced, and does not show its virulence till after two or three weeks. Some persons employed in gilding, have escaped for years; and some who have used peculiar caution, have entirely escaped. This last circumstance should be an encouragement to the manufacturer to employ all the means in his power to avoid the fume, as he is sure to be rewarded. I believe, many of the workmen in Birmingham interpose a plate of tin, between themselves and the pan in which they shake the gilding metal, through which they are enabled to see by means of a piece of glass; and some shake the metal in a kind of cage. Other contrivances may easily be
invented

invented and employed, for driving the current of air constantly up the chimney, and thus preventing the effects of any sudden blush of fume upon the operator: and surely ingenuity cannot be better employed, than in inventing those means which shall protect the health, and thereby prolong the lives, of industrious and valuable citizens.

The indications of cure are these:

1st, To discharge or correct the poison.

2dly, To restore the strength of the body; and thus obviate its effects.

In the first stage of the mercurial disease, its deleterious effects are frequently obviated by a spontaneous effort of nature, by vomiting or diarrhoea: this effort ought to be encouraged or imitated, by such medicines as will operate freely, though mildly. Ipecacuan, castor oil, and flowers of sulphur, are of this number, and hence are best adapted for the purpose.* When a sufficient discharge has been procured, the lower parts of the body may be bathed in warm water, and a gentle diaphoretic, such as a few grains of the compound powder of ipecacuan, be administered at bed-time. This plan will generally carry off the disease at once, if it has not been long accumulating in the system, and

will immediately prepare the way for the second intention of cure, the use of tonic medicines. But when this is not the case, when the disease has been suffered to make a gradual and silent progress, without any complaint from the patient, and without any attempt or application for relief, it is necessary that the same means be employed, but with more vigour, and for a longer time. To the ipecacuan should be added tartarised antimony, which will serve to operate both as an emetic and cathartic, and, in fact with the purgatives, and diaphoretic mentioned before, should be persisted in, till the excretions seem to be duly restored. With these medicines, the corrective plan is not inconsistent, indeed they form a considerable part of it: for if there is any other mode of correcting the poison so administered, and diffused over the constitution, as it is by fume, it most probably consists in the operation of sulphurets and alkalies, powers capable of altering it when out of the body. The preparations of sulphur, and the mild alkalies, may be given internally, or they may be applied externally, in the warm bath; a remedy of itself most powerful, in promoting perspiration, and which, therefore, should be used either alone, or impregnated with the above correctives, as may seem expedient.

When the first intention of cure is fully answered,

ed, then may recourse be had to the second, which consists in the administration of such tonic medicines, as are appropriated to restore that strength to the body, which it has lost by the operation of the poison. On this topic I shall not enlarge: the means necessary to be employed for the restoration of the strength of one poisoned, are not peculiar to that state; and they are so well known to consist in bark, iron, &c. that I shall not repeat them.

I have known no instances in this country, of the mercurial fume producing its most terrible effect, immediate apparent death. Should this ever happen, bleeding, sinapisms, the warm bath, volatile alkali, electricity, and all the other means for restoring suspended animation, should be employed, in the order most likely to be beneficial, according to the existing circumstances.

Perhaps the following order would be as proper as any. Open the jugular vein while the warm bath is preparing, and at the same time let the vapour of volatile alkali be applied to the nose, and other sensible parts. Let the body be rubbed with salt, respiration imitated, and some air injected into the lungs, and glysters of salt injected. If signs of life appear, vitriolated zinc should be given as an emetic, and other stimulants, wine, &c. appropriate to the degree of vitality.

But

But it is, perhaps, of much more consequence to shew how the disease may be prevented, than how it may be cured. — The first, and most important preventive, consists in avoiding the fume altogether. This end may be accomplished by many mechanical means, by caution, and by vigilance. If, however, the workman by chance be exposed to the mercurial fume, its effects may be accelerated or retarded, by attention to some moral, as well as prudential considerations,

I have before remarked, that intemperance or dirtiness were great auxiliaries to the virulence of the poison, and that the infection was probably often occasioned by the operation of these and other debilitating powers upon the body. As to intemperance, it is hardly necessary to observe, that every kind of labour is embittered by its indulgence, and that not one is assisted by it. No prejudice can be more erroneous and absurd, than that the use of fermented liquor is necessary to support the labouring man under his toil. The great Dr. *Franklin*, who rose from being a journeyman printer, to the highest station of a free state, was never used to drink any thing but water during his work; and when his fellow-labourers laughed at him for his temperance, and told him that it was impossible to work without drink, he shewed them by his own example, that it was not only possible, but
that

that he who never drank strong liquors, could work more than those who did. In a familiar train of reasoning, he demonstrated to them that a penny-loaf must contain more nourishment than a quart of ale, as there was more grain in one than the other, and therefore would enable a man to go through more work. It would be well for mankind in general, and for the laborious part in particular, if these sentiments were more general. A proper and moderate quantity of fermented liquor, is certainly useful to the labourer, and he deserves the enjoyment: but excess renders him incapable of pursuing his employment, to so great advantage as he might; exposes him more especially to any dangers attendant upon it, as in the subject in question, and renders him up an easy prey to infection and disease.

In this disease, dirtiness is of more immediate consequence than intemperance, as particles of mercury will be more easily retained, and by the habits of the individual will not be washed away. It cannot therefore be too strongly inculcated to those who are employed in gilding, or indeed any other work where metals are used, to adhere to the strictest rules of cleanliness. They should not only most constantly wash every part of the body exposed to the air, whenever they leave work, but they should also shift their cloaths when they return

home in the evening, and those garments they work in, should be washed as frequently as possible.

I have rested longer upon the diseases afforded by the fumes of mercury, as I thought it might be useful for the information of those who have no opportunities of seeing them; and useful to the health of a valuable order of men, to have them considered and discussed.

3. ANTIMONY.

WE are indebted to the alchemists for the discovery of the properties of this metal; and its advantages to mankind so well counterbalance its malignant qualities, that the discoverers must be ranked among the first benefactors of the medical art.*

Antimony, in its crude metallic state, is inert,† from being joined to a very large portion of sulphur; and all its preparations are proportionally inactive, as they contain this mineral. Those which have no sulphur in their composition, are very active, but they become less so by various other combinations, with nitre, and with alkalies. None of the preparations of antimony have the violent emetic effects of the pure oxide, the regulus, and the glass of antimony, that with oxygenated muriatic acid alone excepted. This latter composition,

* They certainly would have been exempted from the penalties of the Indian law mentioned by *Strabo*. "For the law was, that whoever invented any thing of a deadly or destructive nature, unless also he found out a remedy for it, should himself be put to death; but if he found such remedy, he should be deemed worthy of honour and reward from government." — *Strabo* Geogr. lib. 25. c. 4.

† *Basilus Valentinus* olim ad sues pinguefaciendas ejus usum commendavit. — *Hoffman* Obs. Physico Chym. lib. iii. ob. 3.

composition, which is vulgarly called butter of antimony, is one of the most corrosive substances known, and the most virulent of all the productions from antimony. Applied to the skin, it even more speedily destroys its texture, than nitrated mercury; and taken into the stomach, it instantly produces that constriction of the œsophagus and stomach, which always follows the other corrosives,* with excessive heat and thirst, dreadful pain, vomiting and purging, sometimes of blood, full quick pulse, which terminate in cold sweats, cessation of pain, hiccup, convulsions and death.

If there can be any distinction made of the symptoms, from those of nitrated mercury, it is, that the vomiting is more severe, and that the salivation is less constant: in other respects they will be very similar.

On dissection, the mouth, œsophagus, and stomach, and indeed every other part touched by the poison, will be found inflamed, corroded, and mortified.

I do not think that any tolerably distinctive marks of discrimination, can be given on the action

* Afferam Illud Butyrum Antimonii per errorem exhibiti, statim consecutis faucium & stomachi constrictione, & ardore immani. — Morgagni Ep. lix. 374.

tion of this and the other corrosive poisons. They will all corrode and inflame the parts they touch, and the appearances of these corrosions will much depend on the quantity of the poison taken into the stomach, and the form in which it is taken. They none of them can be mistaken for the irregular jagged corrosions, which take place in the stomach after death, by the action of the gastric liquor, as they will be in some wise regular, and always surrounded by the appearances of inflammation.

Of the peculiar operation of the antimonials, we can say little more, than that their chief tendency is to excite vomiting, as that of the mercurials is to excite the salivary secretions. They, no doubt, have the power of diminishing or abstracting from vitality, else, how can we account for their usefulness in active inflammations? Certainly not from their being mere diaphoretics.

The operation of butter of antimony, when externally applied, is subject to the same restrictions, as nitrated mercury; what has been said, therefore, on that head, will be equally applicable on this.

When butter of antimony is found in the stomach, it may be known from nitrated mercury, by not giving out red fumes when exposed to heat:
and

and likewise by a copious precipitation of a white powder, when thrown into pure water.

The term of action of this, and all the other corrosives, is limited by the possible duration of inflammation, which has been known to terminate in eighteen hours, when the disease was in the stomach and bowels. From this period then, to three or four days, may existence be prolonged, when the worst effects cannot be prevented. It must be observed, however, that the means most likely to be pursued, on account of the feelings of the patient in this case, will be probably beneficial, and give a better chance for recovery than in many others. His thirst will compel him to drink, and the fluid he takes into his stomach, will decompose the poison, deprive it of its corrosive qualities, and add to its emetic ones, and consequently contribute to its discharge.

Hence the indications of cure are obvious. — For correcting the poison, we have only to pour a very large quantity of water into the stomach, and the very mean we take to correct it, will convert the poison itself, into its own evacuant. With the aqueous fluids, mild alkalies may be added, they will perhaps render the antimony less active in its operation, and at any rate they cannot be injurious. Sometimes the stomach, from being too strongly
excited,

excited, cannot discharge its contents; in this case a dose of opium will be necessary, to restore the just ballance of action: but this remedy should be administered with great caution, and only where there is absolute necessity. It will be seldom necessary to administer vitriolated zinc, as an additional and more speedy emetic. The urgency of the symptoms may render its use, in some cases, expedient, as where there is not sufficient acid in the stomach to render the precipitated oxyd of antimony emetic; and then a glass of vinegar, or the alkali, would have the same effect. But the aqueous and mucilaginous liquors, those simple means which are in every body's hand, and which may be always employed in large quantity without fear, are the remedies to be chiefly depended upon.

As soon as it is certain, that the poison is either corrected or discharged, if there are any symptoms of inflammation, they must be treated by the usual antiphlogistic plan. In all the cases where corrosive poisons have been taken, the general treatment must be the same. The only difference that can be specified, is in the chemical corrective to be used. All the rest must be left to the good sense of the practitioner, guided by the nature, and the strength of the symptoms.

The glass of antimony has been supposed, by
some

some authors, to produce specifically poisonous effects, independent of its stimulant action as an antimonial, which is indeed excessively violent.*

“Cognita nobis sunt exempla aliquot, ubi vitrum antimonii in substantia propinatum non secus ac arsenicum, intra aliquot horas mortem intulit,” says *Hoffman*.†

A scruple of vitrified antimony was given to a cat, by *Wepfer*.‡ The animal seemed to suffer much pain, but did not vomit, till an hour after it had been swallowed.

In another case, a cachectic woman, troubled with difficult breathing and a palpitation of the heart, took a few grains infused in white wine. She was attacked with enormous vomitings, and was found insensible. The vomitings did not cease, till she had taken plentifully of diluting liquors. When she had a little recovered her strength, she complained of intolerable pain in her right foot, which in the end became sphacelous, and was cut off. When every thing was apparently doing well, she was seized on the fifteenth day after the amputation, with a suffocative cough, in which she expired.

OR

* *Morgagni de sed. & caus. Morb. lix. §. 6.*

† *Obs. Physico—Chym. lib. iii. obs. 16.*

‡ *Hist. Cicut. Aq. c. xx. p. 320.*

On dissection, the lungs adhered to the right side, and were much spotted : where they did not adhere, a quantity of water was found in the chest.*

If we are to judge from this case alone, there is certainly no reason for attributing to the vitrified antimony, any effects that are not common to the other oxides. The experiment on the cat, seems also to justify this opinion. But it was not only with this view that I adduced the case in question. As there are several causes which may be assigned for the death of the patient, it will be useful to mention them, in order that we may be aware of the deceitfulness of the first appearances of some of the causes of death, and may be more cautious in our judgments and decisions concerning them.

In the first place, death may have taken place from the water in the thorax ; secondly, from the adhesion ; thirdly, from the sphacelus. That the four grains of vitrified antimony did not produce it, is probable, because her difficulty of breathing does not seem to have been increased by it ; and though its operation was violent, yet it was more likely to cause absorption, than to induce dropsy. The sphacelus of the leg, was full as likely to be produced

* Hist. Cicut. Aq. p. 322.

produced by the general bad state of health, as by debility from the action of the poison. That these consequences did not follow the immediate action of the poison, is not asserted; indeed there seem to have been none of the immediate symptoms produced — no pain or inflammation. — Had this woman eaten any thing of the most simple kind, the same vomiting might have come on, with the same consequences, and yet they would have been the effect not of the vomiting, but of her previous bad state of health.

The operation of the pure oxides of antimony, is that of the most active emetic kind, when they meet with a sufficiency of acid to dissolve, and of fluid in the stomach, to apply them to its internal surface. Such is their amazing activity, that they produce this operation from a quantity hardly to be calculated. In doses therefore of a few grains, their stimulus may be so violent, as to produce inflammation of the stomach, with all its terrible consequences, independent of any other operation.

The saline preparations of antimony are also very active, but not so much so as the pure oxides, they proving only gently emetic in the quantity of some grains, and a few of them, when united with nitre and absorbent earths and alkalies, can be given
in

in still larger doses, without danger. When given in too large quantity, they are all distinguishable by their violent emetic operation, and therefore are all, to a certain degree, dangerous. Tartar emetic excited inflammation in the stomach of a dog;* and there are many instances of its bad effects, when administered in too large a dose, on the human body.

When externally applied, the oxides of antimony, and their saline compounds, are all capable of producing their appropriate effects: but to produce them, much larger quantities are required, than when taken immediately into the stomach. In some cases related by Mr. *Sherwen*,† ten grains of tartar emetic were rubbed into the hands, and produced general irritation, and some sickness. We may conclude from these experiments, that the antimonials are much milder in their operation when externally applied, than when taken internally, and that in this form they are not much to be dreaded.

D d

The

* *Tartarum vero emeticum* Vir alter experiens Jacobus Felix cum dedit Cani, & vomentem adhuc aperuisset, maximam ad Pylorum inflammationem, per aliquot pollicum Spatium vidit. — *Morgagni de sed & caus.* lix. 374.

† *Mem. London Med. Soc.* vol. ii.

The preparations of antimony in general, may be discriminated from those of mercury by their taste; but as all of them will be materially altered in this respect by the contents of the stomach, this criterion is not to be depended upon alone. By heat the oxides of mercury soon fly off in the form of vapour; this is not the case with the oxides of antimony, which are little altered by very high degrees of heat. The oxides of mercury may also be restored to their metallic form, by chemical process.*

The term of action of the antimonial oxides, will be much the same as that of the other substances which act by stimulating the stomach too violently, and thereby exciting inflammation.

The cure must be undertaken with the view of discharging the offending substance, and sheathing the stomach and intestines from its virulence. For these purposes the diluent plan must be resorted to in its fullest extent. While the preparation of antimony remains, it is useless to give any other medicines than those which will assist its discharge. Thus, if the stomach be too strongly excited, an opiate must be given with the aqueous and mucilaginous liquors. When the active and immediate operation is overcome, its consequences should be prevented,

* Galls precipitate mercury from solution of a yellowish colour—Antimony of a bluish-grey.

prevented, as much as possible, by avoiding any stimulating medicines, and persevering in those moderate remedies which heal and guard against inflammations, as broths, gentle evacuations, &c. &c.

I shall conclude with *Newman's* abridged account of the effects of the various preparations of antimony, from *Hoffman*. — He observes :

“ 1. That crude antimony, on account of the regulus being corrected by the sulphur, is not only safe, but in many respects a medicine of great service, both for man and other animals.—2. That by simple fusion, it acquires a degree of malignity; but a far greater, if melted with half its weight of nitre, which consumes nearly all the nitre, and leaves the regulus bare. — 3. That antimony, or its regulus, mixed with common salt, calcined over a gentle fire for several hours, and kept continually stirring, and afterwardsedulcorated with water, yields an ash-coloured calx, which is so fixed as to bear a melting heat, and proves a mild and safe diaphoretic. — 4. That antimony, by calcination with a gentle heat in an earthen vessel, changes into a calx which melts difficultly, and has no malignity. — 5. That if this calx be melted with a strong fire into glass, it becomes so active, that a few grains shall occasion violent vomitings, purgings,

ings, or even mortal convulsions and death.—8. That equal parts of nitre and antimony, melted together, yield a virulent mass; but one part of antimony, with two or three of nitre, an useful diaphoretic.—9. The same happens with the regulus.—10. That on melting the diaphoretic calcis with fat, or charcoal, or nitre, the virulent regulus is revived.*

The following is Dr. *Black's* list of the preparations of antimony.

1. By triture. — Prepared antimony.

2. By the aid of fire and air.

Flowers of antimony.

Glass of antimony.

3. By the power of alkaline salt.

The mild hepar of antimony; or,

Medicinal regulus of antimony.

Kermes mineral.

Precipitated sulphur of antimony.

4. By the power of nitre.

Mild antimonial crocus.

Nitrated calx of antimony.

5. By

* *Newman's Chemistry*, vol. i. p. 99.

5. By the power of acids.

Vitriolated antimony.

Antimonial caustic, or butter of antimony, or

Muriated antimony.

Powder of algaroth.

Bezoardic mineral.

Tartarised antimony.

This metal, according to the different modes by which it is separated from sulphur, is called, simple regulus of antimony, martial regulus, &c. &c. From it are prepared,

1. The snow of antimony, by the assistance of air and fire.

2. With nitre,

Cerusse of antimony.

The cinnabar of antimony, and the tincture, scarcely retain any particles of this mineral.

4. SILVER and GOLD.

SILVER, when taken into the bodies of animals in its pure metallic state, is entirely harmless; but when joined with the nitric acid, it forms a most corrosive compound. The smallest portion of nitrated silver, applied to the skin, marks it with a blackish spot, and consumes it, till its powers are exhausted.

The oxides of silver, as far as I know, are not injurious to the health of animals; and few of the acids or alkalies act upon the metal forcibly. Indeed of the acids, the nitric alone acts so thoroughly upon it, as to render the compound an object, of commerce or of medicine.

The muriatic, and the nitro-muriatic acids besides, form corrosive compounds; as does the sulphuric acid in a boiling state; but these preparations are only to be found in the elaboratories of chemists. — The alkalies do not affect silver.

Of all the compounds of silver with acids therefore, that with the nitric acid is the most to be dreaded, on account of the frequency of its use in
medicine,

medicine, and consequently the ease with which it is procured.

Taken into the stomach, nitrated silver produces all the consequences which follow the improper use of nitrated mercury, or of any other substance capable of corroding the texture of the part. Excessive pain, sickness, thirst, with vomiting and purging of blood: these, if the quantity swallowed were large, must proceed to mortification and death.*

On dissection, the appearances will be the same as if nitrated mercury had been swallowed; corrosions surrounded by the appearance of inflammation,

The external application of nitrated silver is circumscribed exactly within the same limits as that of the other corrosives. The injury they do, must depend upon the part to which they are applied. The application can be seldom so extensive, as to cause immediate danger of life, without sufficient warning being given previously to the patient; and yet may they be applied in such a manner as to render its continuance but of little value.

D d 4

If

* Nitrate of silver, taken for an obstruction of the liver for several months, changed the skin gradually, nearly black. The colour lasted several years, but is now wearing off. — *La Médecine éclairée par M. de Fourcroy*,

If nitrated silver be found in the stomach, it may always be discriminated by mixture with a solution of common salt, which precipitates it entirely, and the precipitation, on exposure to light, becomes blackish. Galls precipitate silver from solution in reddish stræ, which afterwards appear like burnt coffee.*

The quantity of nitrated silver that may occasion death, will vary according to the state of the stomach at the time of its being taken, both with respect to its health at that particular time, and what it may accidentally contain. If it contain a considerable quantity of mucus or fluid, it is less likely to be injured.† But if the sensibility of the body, and its susceptibility of inflammation, be greater than usual, much less nitrated silver than is commonly hurtful, may produce the most fatal effects. Some authors‡ recommend it, in doses of five grains,

* *Fourcroy Elements of Chemistry, Note Transf. vol ii. p. 532.*

† *Ex argento, chrysalis lunæ præsentissimæ corrosivitatibus, nonnulli pilularum forma ad hydropicas aquas utuntur educendas, quod etiam faciunt, si magna copia liquidi quo ejus corrosiva acrimonia diluatur, desuper hauriatur, cauto tamen hic opus est, enim notavimus ab hujusmodi pilulis repetita dosi datis, cruentas sedes cum ingenti virium lapsu successisse.* — *Hoffman de inséc. Med. tom. vi. p. 313.*

‡ *Partridge's Treasury of Physic, p. 21, originally written in Latin by Hadrianus a Mynsicht, a book in vogue during the last century. We may form an accurate judgment of its merits from the first medicine in it, the Unicornu minerale, "a glorious, mysterious, universal medicine, and "such a treasure, that is able to cure all diseases, by what name soever "they are called in all and every creature."*

grains, but I trust their recommendation will never be followed by any persons of common sense or prudence. Even in smaller doses than these, I believe it is capable of being injurious, and even fatal; indeed is a medicine so much to be dreaded, that its *internal* use should be abstained from altogether. We cannot be certain that the stomach may not be met with in some irritable habit, in such a state as to be inflamed by the smallest quantity of it, but we well know that other medicines answering every intention for which it may be administered, can be given without risque.

The time in which the corrosive poisons may operate, is nearly the same in all. It is limited by the shortest possible duration of active inflammation, which has terminated in eighteen hours.

The cure of all the corrosive poisons must be undertaken with nearly the same intentions.—The stomach and intestines should be sheathed by very copious draughts of oil, milk, mucilage, or even water. With the alkalies, common salt may be administered to correct, and vitriolated zinc to discharge the poison. In the case of nitrated silver, common salt being always at hand, is a corrective which should be very copiously used, and indeed none other is requisite.—Of the state succeeding
the

the expulsion or correction of the poison, I have spoken before, under the head of nitrated mercury.

Besides this corrosive preparation, silver furnishes another, remarkable for its fulminating power. An oxide of silver, precipitated from its solution in nitric acid by lime water, and exposed for three days to the air and light, in the heat of 120 deg. bursts into a tremendous explosion, even in the small quantity of a grain.* Whether this dreadful preparation can be conveyed into the stomach, and whether it will act there as a corrosive poison, are problems yet to be proved. — Its similarity to fulminating gold, has induced me to place it here.

GOLD only becomes active by solution in the nitro-muriatic acid, and by precipitation from that solution, by means of volatile alkali.

Of the solution of gold in the nitro-muriatic acid,

* Prenez de l'argent de coupelle, dissolvez le dans l'acide nitrique, Precipitez l'argent de cette dissolution par l'eau de chaux; decantez & exposez le Precipite pendant trois jours a l'air.

La poudre a canon, l'or fulminant meme ne peuvent pas etre compares a ce produit nouveau.

Une goutte d'eau tombe de haut sur l'argent fulminant, l'a fait fulminer. — Journal de Physique, 1788, p. 474.

acid, the phænomena are well known, and it is an established fact that its effects are corrosive. Probably they are as much so as those of nitrated silver; we have, however, no other grounds to proceed upon, than the analogy they seem to bear to each other.

Of the fulminating gold our knowledge is rather more precise. *Hoffman, Rolfincius, Plenck,* and *Gmelin*, have all recorded instances in which, in the quantity of six or eight grains, according to the state of the patient, it produced very alarming, and even fatal consequences, when taken internally.

An infant was seized with tormina and spasms, and soon after died, from six grains.

An hypochondriac had anxiety, spasms, tormina, fainting, and cold sweats, from four grains.

An irritable scorbutic woman was purged twenty times, with tormina, fainting, &c. from two grains.*

From these, and many other instances, it appears to be a very acrid stimulant, which may
prove

* *Hoffman*, tom. vi. p. 312.

prove fatal in very small quantity, and which must be remedied by those means employed in cases of corrosive poisons.

Gold in solution may be discriminated by staining tin of a purple colour.

5. COPPER.

IN its pure metallic state, copper is harmless. But it is so easily combined with all the acids and neutral salts, with rancid oils, and with the alkalis, that it may be readily taken into the stomach; and it can be taken in no shape, without the most imminent danger. In food, it may be combined by the process by which our aliment is prepared for the table. With wines, and even water, it will be mixed, if they contain but the smallest portion of acid.* And in fact, we can never be entirely secure from the danger of this poison, till every utensil containing copper is banished from the kitchen, and till our cooks are forbidden, under the severest penalties, from improving the colour of preserves, at the risk of health, or even of life.

Against its malicious use, we can only employ our knowledge to detect, and our skill to heat its bad effects.—In the one case, to drag the assassin before the tribunal of the laws, and in the other, to pour balm into the wounds of the sufferer.

The

* On the different modes of its combination, and the facility with which it may be mixed with our aliments, see the very useful treatises of the learned Drs, *Falconer* and *Fothergill*, of Bath.

The symptoms from copper are various, according to the preparation taken, and the situation of the patient at the time. — If nitrated copper be swallowed in any quantity, its corrosive qualities will produce all the bad effects of that class of poisons, besides the other symptoms that are appropriate to copper. — From the other corrosives, it will be discriminable on this latter account, and from the other preparations of copper, on account of its corrosive qualities.

When the vitriolated, acetated, or ammoniated copper are swallowed in any quantity, instantaneous vomiting generally takes place, especially from the vitriolated and ammoniated. — If the poison be not discharged by the vomiting; eruptions of the skin, excessive thirst, sometimes violent purging, at others costiveness,* with the desire, but not the power of discharging any thing, follow, with shifting pains of the stomach, belly, and sides, which are severe and griping from the first, but seldom encrease to that degree of anguish as in cases of arsenic and corrosive sublimate. The tongue is dry and white, the skin parched, the eyes red and wild, the pulse beats quick and hard, and respiration is performed with anxiety and distress. If the patient be not relieved from these symptoms,

* *Plenk de Venenis, p. 245.*

symptoms, they proceed to cold sweats, delirium, convulsions, great swelling of the body, and death. During the whole course of the vomitings, which are very severe, the taste of copper will be perceptible to the patient, and the matter rejected both by vomiting and stool, will most frequently be tinged of a green colour. These are the general symptoms, which I shall beg leave to illustrate by some examples. Variations will occur in all cases, from a thousand unforeseen or unknown circumstances, but the outline is sufficiently marked, not to be mistaken.

“ Three seamen of the Cyclops frigate, having
 “ eat some victuals prepared in a fowl copper,
 “ complained soon after of violent gripes, giddi-
 “ ness, and vomiting, and they had a few loose
 “ stools. There was intense heat, the pulse full,
 “ quick, and hard, a tremor of the hands and
 “ tongue, and wildness of the eyes. The loose-
 “ ness was soon succeeded by obstinate costiveness,
 “ tension of the abdomen, difficult breathing, and
 “ loss of deglutition. In the night, towards the
 “ morning, there came on insensibility, with an
 “ increase of all the symptoms except the heat.
 “ The body was violently convulsed, with cold
 “ clammy sweats, and coldness of the extremities.
 “ The abdomen subsided a short time before they
 “ died, and a small quantity of greenish matter,
 “ mixed

“ mixed with phlegm, issued from two of their
 “ mouths. Thirty-three other men were put upon
 “ the sick list with similar symptoms in a less de-
 “ gree, and some of them continued on the list for
 “ five or six weeks before they perfectly recover-
 “ ed.”*

“ A delicate young lady, while her hair was be-
 ing dressed, amused herself with eating samphire
 pickle: this was on the 25th of August. Thirst
 came on soon after she had eaten the pickle, and
 the same evening she complained of pain in her
 stomach, and perceived a rash upon her hands and
 breast. She passed several days without a stool,
 and felt an universal foreness with shifting pains.
 On the 30th of August she began to vomit. The
 retchings were incessant on the 31st, with a dis-
 charge of samphire, &c. of a green colour. Her
 stomach was prodigiously distended. She died the
 3d of September, nine days after eating the pickle
 impregnated with copper.

On dissection, the internal coat of the stomach
 was found inflamed and gangrenous, particularly
 about the pylorus, and this appearance extended it-
 self some way down the duodenum.†

The

* Gordon in *Blane's Obs. on the diseases of seamen*, p. 298.

† *Percival in Med. Transactions*, vol. iii. p. 80.

The most dreadful convulsions he ever saw, Dr. *Percival* says were produced by two drachms of vitriolated copper.*

A boy who swallowed a halfpenny, was so sick the succeeding day, that he could retain nothing upon his stomach. He vomited a large quantity of a green-coloured fluid, which had the smell of verdigris. In the evening a glyster was injected, the halfpenny came away, and the boy recovered.†

Newman knew a person, who having accidentally swallowed a brass sleeve-button, was seized with violent symptoms, and died in misery, no medicines giving relief.‡

Neumann likewise mentions, that he has seen very severe vomitings, with gripes and convulsions, from the application of the unguentum ægyptiacum to the mouths of children. I have known the same inconveniencies arise from the use of a cupreous ointment for the cure of aphthæ, and in one case the life of the child was saved with difficulty; though from the quantity of ointment applied to the mouth, the portion of copper taken into the stomach must have been very small.

E c

On

* *Percival* in Med. Transactions, vol. iii. p. 88. † *Ibid.* p. 87.

‡ *Neumann's Chemistry*, vol. i. p. 98.

On dissection, the stomach and intestines are always found inflamed and mortified, from the internal use of copper. By the nitrate of copper, they may be corroded also, but this is the only one of its preparations that will have this effect.

Copper, applied in substance or solution externally, may certainly affect health, but can seldom be applied so universally or continually, as to destroy life in any short time. When rubbed by the fingers, copper emits a foetid odour, which adheres to the skin for some time. Dr. Falconer quotes a case from the Medical Museum, in which a person lost the use of his hands by cleaning brass wire.*

A girl who was under my care, for a very obstinate eruption of the hands, arms, and neck, with griping pains of the stomach and bowels, and costiveness, could give no other account of her disease, than that she was the servant of a person who washed silk stockings, and was employed in that work herself. She did not know the composition of the wash, as it was kept secret, but from her description of its blueness and smell, I have no doubt it contained copper. I advised her to leave her employment, and she soon afterwards got well.

In

* On Copper, p. 30.

In fumes, the external application of copper is not so deleterious as that of mercury, and the other poisonous minerals. I have rarely seen any of the persons employed in melting brass, or working in copper, great numbers of whom live in Birmingham, affected to any considerable degree. In some few cases however, diseases occur, probably from inattention, intemperance, or want of cleanliness. Bad taste, pain of the bowels, irregularity of their motions, nausea, and slight tremors, are the worst symptoms I have met with in the workmen of brass-founderies, palsies never, but in some of them a tendency to phthifical complaints.*

E c 2

Ramazzini

* The case of Mr. Butler, related in the 50th and 54th vols. of the Phil. Transf. is very remarkable, and demonstrates that constitutions so irritable, may be found occasionally, as to be affected by the external use of copper in very small quantities; and also of many other metals, which are innoxious to the bulk of mankind.

“ The handling of verdegriſ, vitriol, copper, or iron, gave him anxiety, tremor, faintings, and many other uneasy ſymptoms.”

In the 54th vol. his caſe is very minutely deſcribed; when he was affected with the following ſymptoms from touching with the middle finger of his right hand, a compoſition of blue vitriol, alum, lime, and alabaſter. Three hours afterwards, he found pain in his arms, he was ſick, and felt a trembling over his whole body, with faintneſs. Before he perfectly recovered, he had many paroxyſms ſimilar to the one with which he was firſt attacked: and it is moſt probable that theſe attacks aroſe from the metals, as they were a certain conſequence of their being handled.

“ One day having got home a box of ceruſſe, he took out ſome lumps
to

Ramazzini says, that the subtle atoms which exhale from copper, change the hair of the workmen green, and when they enter the lungs, raise a dry cough, &c.* *Galen* ascribes a difficulty of breathing to the workmen who carried water from a cave in Cyprus, impregnated with copper.†

On the whole, from the indecise manner in which the danger of the external use of copper is spoken of by some authors,‡ and the great use that has been made of it in all ages, we may conclude, that it has not been very generally found deleterious in this mode of application, though when given internally, it is always so virulent a poison.

There is little difference in the degrees of virulence of the preparations of copper; that with the nitrous acid, and, perhaps, with the oxygenated muriatic

to examine the quality. In a few hours afterwards, he was taken with anxiety, palpitation of the heart, and a sense of trembling and a weakness of the whole body."

* De Morb. Artif. c. vi.

‡ Aeris odor visus est suffocans & toleratu difficilis, chalcitini æruginemque redolens.—De simp. Med. fac. lib. ix. p. 71.

‡ In asthma, "death is protracted to labourers, whose lungs are heated and dilated, in some employments, such as lime copper-works."—*Arctæus* Morb. diut. lib. i. p. 40.

muriaric acid, excepted. — Dr. *Falconer* places them in the following order.*

1. Nitrated copper.
2. Muriated copper.
3. Acetated copper.
4. Ammoniated copper.
5. Sulphurated copper.

The green rust which is found on antient metals is also very active. With rancid oils, copper probably becomes ammoniated. With neutral salts its combinations are milder than any of those above enumerated. Few of the preparations of copper can be given in larger quantity than four or five grains without danger. In the cases before related, the portions acting must have been very small. Much of the halfpenny, and the whole of the sleeve-button, was not dissolved, though such violent effects were produced.

Sulphate of copper is sometimes given as an emetic in doses of a few grains. and is generally discharged by its own operation; should it chance ever to remain behind, the quantity of ten or twelve grains is capable of destroying life.†

E e 3

Ammono-

* On Copper, p. 36.

† Great anxiety from six grains. — *Hoffman Med. Rat. Sys.* tom. ii. p. 290.

Ammoniated copper produces sickness in the quantity of half a grain or a grain; from eight or ten therefore, inflammation would most likely follow. It is impossible then, that too great caution can be displayed in guarding against this poison, which, from the quantity in which it acts, lies particularly open to the designs of malice, and which by art or by negligence, may be so easily introduced into our nourishment, and taint the sources of life, at the moment that we are endeavouring to preserve it.

When copper is found in the stomach, there will be no difficulty in discriminating it from every other poison, under whatever form it may lurk. Volatile alkali converts all the solutions of it, to a beautiful blue. *Bergman's* phlogisticated alkali, precipitates it from solution of a darkish red. Galls precipitate it of a green, afterwards turning red. It is likewise precipitated from solution in its metallic form, on polished iron.

Copper seldom destroys life in less than two or three days. In the case of the samphire pickle, nine days elapsed before its operation terminated. The progress here was probably occasioned by the gradual evolution of the copper by the process of digestion. In the first instance, there was a sufficiency to excite uneasiness, and to produce costiveness:

ness: life was gradually consumed by the remainder being detained in the body, and not acting at once, but coming forward by morsels. Had the young lady taken as much acetated copper in a liquid form, as was contained in the samphire, she probably would have escaped. The worst symptoms appearing at once, would have given the alarm, whereas from the mode in which it was taken, life was undermined, before danger was apprehended.

Why copper should take a longer time to abstract the vital principle, than the virulent corrosive poisons, I cannot explain. That the general action of all the virulent poisons, is to a certain degree alike, I do not doubt; but what are those circumstances which allow life to continue forty-eight hours, or three days, in cases of copper, whereas from arsenic people die in four or five? The accession of the symptoms in the first case, is as quick as in the latter, for copper, though taken into the body in its metallic form, begins to act the moment it meets with a solvent.

The distinguishing symptoms of copper are the instantaneous vomiting, and the green colour and cupreous smell of the matters discharged. The taste of every thing that contains this metal is peculiarly nauseous, and is well known by the name

of a coppery taste. This last symptom is not absolutely a criterion, as some of the mercurials afford a taste which is very similar to that of copper; when, however, it is conjoined with those other symptoms which never succeed in consequence of mercury, it may be depended upon. Copper is said to produce an inability to open the fingers, but not the same flabbiness of the muscles as lead.* Most of the other symptoms are common to the acrid poisons. The intense heat, fever, and griping pains, are perhaps aggravated in the virulent and corrosive poisons; and they are attended with a burning sensation in the throat, which does not follow the swallowing of copper. The duration of the symptoms will also distinguish it from most of these poisons.

The cure of those poisoned by copper, must be undertaken with the same intentions, and in general pursued by the same means, as in other cases of poison. Our hopes of correcting indeed, cannot be very great, as all the solutions of copper are deleterious; yet we may render them less noxious by combination, and thus partly fulfil a very material indication of cure. — When the poison has been taken but a short time, the first attempt should be to discharge it, by pouring large quantities of aqueous and mucilaginous liquors into the stomach, and

* *Falconer* in *Mem. London Med. Soc.* vol. ii. p. 224. — Consult likewise the seasonable cautions of the learned *Dr. Fothergill* of Bath, concerning the mischiefs arising from copper and lead in culinary vessels, &c.

and by administering at the same time a good dose of vitriolated zinc. — When the poison has been taken a considerable time, an active emetic may often be of service, as in the case of the young lady related before, who vomited up some portions of sapphire seven or eight days after it had been eaten : but as it must be imagined long before this time to have commenced its attack on the constitution, other efforts must be also made to obviate or heal its bad effects. Mild alkalies, hepar sulphuris, or flowers of sulphur, should then be given; and they may be applied without any active evacuants, when we are certain that the poison is for the most part discharged. If the poison either were taken in its metallic state, or be supposed to have reached the intestines, by no more of it being discharged by vomiting, recourse should be had to brisk cathartics, as scammony or jallap, which may be given with good effect, along with castor oil, or even common oil. Acids, in all cases, must be carefully avoided. Small portions of copper taken at intervals in food, may accumulate in the body, and I believe that this mode of taking it, is a much more frequent cause of disease, than is generally known or imagined. If this should be known to happen, the stomach must be cleared by repeated vomits of ipecacuan, and the body kept open by flowers of sulphur. The demulcent and diluent plan may be pursued here with advantage; and
the

the patient may use the sulphurated bath. Alum is warmly recommended by Dr. Percival, as a tonic, when the poison of lead has been taken into the body. In cases of copper, I think it may be also useful, when the immediate operation of the poison is past, and the patient labours under considerable debility. — The same means that are here recommended for the slow reception and gradual accumulation of copper in the body, will be applicable to its external absorption.

Fortunately the difficulty of keeping nitrated copper conspires with its smell and taste, to prevent its common use; should it however be employed with a criminal or injudicious intention, the cure must be undertaken by the same means, as for the other preparations of copper.

6. L E A D.

THIS poison is more likely to find its way into the stomach without being perceived, than any of those I have yet mentioned. The sweet astringent taste of acetate of lead, commonly called sugar of lead, may be readily mistaken for a harmless composition; and the tasteless, or sub-dulcid oxides of lead, may be swallowed without the smallest suspicion, especially if their colours be not observed.

Lead, in its metallic state, like all the other metals, is probably inert: but it is so easily acted upon by the weakest acids and alkalies, that it cannot be taken even in this form without the most imminent danger.

Mrs. P—, who had long laboured under phthical complaints, with pain of the stomach, and eructations, which, she fancied, proceeded from the rising of the lights, (lungs,) had taken for three days successively, *to keep down the lights*, 240 common sized shot. Her husband observed the shot in her stools, the third day after she began to take them; shortly after, the pain of the stomach was aggravated to a violent degree, the left eye became distorted,

distorted, the left arm and leg paralytic, and she died in about a month.

I was once consulted by a woman, whether she should not give her infant, who had been poisoned by gin, and whose stomach was consequently so weak as to reject every thing, shot to cure this disease, which she called the rising of the lights.

From these cases it would appear, that this fatal prejudice is more deeply rooted, than at first sight could be imagined; and I have related them, in order that its consequences may be more efficaciously counteracted.

Lead has far the precedence of all the poisonous minerals with respect to antiquity, *Nicander*, a poet and physician probably about the the time of *Ptolemy Philadelphus*,* of all the metals mentions only cerusse and litharge as poisons. To the age of *Celsus*, orpiment and copper alone of the metallic substances, were added to the list of the preparations of lead, which he says purge, corrode, and consume the body: those deadly properties are acknowledged by *Pliny*; and mankind are now so well aware that health may be undermined, or even life destroyed, by their reception into the body,

* *Le Clerc Hist. de la Médecine*, p. 330. 4to.

dy, that utensils of lead are generally proscribed by domestic œconomy.*

The effects of lead taken into the stomach, either in the form of oxide, or dissolved in acid, is much the same. In the latter case, the symptoms accede more quickly, as the activity of the oxide depends upon its meeting with an acid in the stomach. In both cases, when the quantity taken is sufficient to produce an apparent operation, if vomiting does not immediately follow, dryness of the throat, with a sense† of constriction and weight in the stomach and intestines, first comes on, with slight and shifting pain. The belly then becomes hard and constricted to the touch, all the excretions are totally stopped, or partially impeded. The pulse is quick and hard, the tongue white, and the pains of the bowels are so intolerable, as to bend the body forward, and are accompanied with general tremors.

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* Of so great and extensive use is this metal in the arts, that it is not very easy to avoid it altogether. It enters into all glazes, it forms the glaze of earthen-ware, particularly of the coarser sort. Some waters contain so much acid, as to dissolve the leaden cylinder which is frequently employed in pumps; of this we have a very singular and fatal instance, in a letter from Dr. Wall to Sir G. Baker.

† Spuma-argenti pota, stomachi, ventris & intestinorum gravitatem inducit, cum torminibus, quandoque etiam intestina fauciat gravitate, & urinas suppressit.

Et qui ramenta plumbi aut loturam hauserunt, similia symptomata habent. — Paul. Ægineta, lib. v. c. 60.

If these pains are not quickly alleviated, respiration is affected, anxiety comes on, with convulsions and cold sweats, and death soon terminates the torments of the patient. The tremors, which accede very early, do not degenerate into absolute palsy, till near the close of the disease. This is the most general course of the symptoms when a very large dose of the oxides, or acetate of lead, produces an immediate operation. In this case the symptoms accede in eight or ten hours in their most violent degree, and terminate in three or four days.

In *Sproegel's* experiments, the effects were more quick upon dogs: * and a number of ducks and geese were killed during a night, † by drinking water impregnated with lead from paint.

A hearty man swallowed by mistake near 3℥ of sugar of lead in ointment; vomiting instantly succeeded, with violent pain of the stomach.

On dissection, the stomach and small intestines are found inflamed, but in a slight degree; sometimes the bowels are constricted. The inflammation is never so marked as from the foregoing poisons,

* Diff. inaug. circa varia venena Exp.

† Percival on Lead, p. 79

fons, in cases of lead, and corrosions cannot take place from it.

But the immediate action of the poison of lead is not the most dreadful: we seldom hear of cases, in which death so speedily occurs from it, as three or four days, the patient being more frequently reserved for the protracted suffering of a week or fortnight, even when the dose was very large.

“ A man for the cure of the gout was advised by an empiric to use an oxide of lead, which he did in such quantity, as to take half a pound in the course of fifteen days. On the twelfth day after he began the use of the lead, he was attacked by dysentery and fever, with such excruciating pains of the stomach and bowels, as not to be able to bear the slightest pressure. Every thing he took was converted into a slimy fluid, with a saturnine nidor, and was quickly returned. The pains continued for twenty days after the dysentery, and during that time he discharged nothing by stool without a glyster. His recovery was preceded by a very obstinate jaundice.”*

“ A woman of tender constitution, with tendency to phthical complaints, took five grains of acetated lead, thrice every day. The sixth day after

* Fernelii *Univerſa Medicina*, vol. ii. c. 7. p. 230.

after she had first taken this medicine, all expectoration was suppressed. On the tenth, she felt slight anxiety, and weight in the abdomen, and the belly was bound. On the sixteenth, the pains in her belly were most grievous." — *Zonamqué ferream, hypochondria acerrime constringentem, æmulantes.* On the nineteenth, having received no relief from emetics, her breathing became laborious, with great anxiety and debility, severe pain, the motion of the arms impeded, the fauces and tongue dry to rigidity, pulse quick, weak, and hard. A glyster with *ol. lini* ʒiv. *diacodium* ʒi. was ordered every two hours, A pint of whey, with ʒi. of manna, and ʒi. of diacodium, for common drink. During the night she had six stools. On the twentieth she began to mend, and on the thirtieth could move her hand. She was entirely free from the saturnine affection, ten days thereafter, but died consumptive during the year."*

In another case related by the same author, a man who took twelve grains of acetated lead every morning for a gonorrhœa, was not affected till the eighteenth day with the pains, but the palsy here was more obstinate. It may be observed, that in the first instance fifteen grains of acetated lead were taken every day, and the apparent operation commenced on the tenth day. In the latter, twelve grains

* Sandifort Thesaur. vol. ii. p. 56.

grains began to operate on the eighteenth day. — The difference in the protracted operation from the immediate, is in the very great weakness of the alimentary canal, and the almost constant accession of palsy, in the former case. The violent pain is the same in both, and they both attack life much in the same way. But when the space of several days has passed from the first taking of the poison, the tone of the stomach and bowels is gradually abstracted; whereas in the other case it is suddenly attacked; and when the worst operation commences, nausea, vomiting, eructations, &c. are particularly distressing.

The saturnine disease is longer in appearing, according to the quantity of lead used, and the power of the body to resist it. In the smallest quantities it produces the disease when taken for a sufficient time; and in proportion to the length of time before the apparent operation commences, the disease perhaps is more obstinate, on account of the vitality of the body being more copiously abstracted. But I shall refer for all farther information on this subject, to the works of a very learned physician* of our own country, who has carefully investigated, and accurately described the colic produced by lead.†

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The

* Sir George Baker's Diff. in first and subsequent volumes of the Medical Transactions; and Dr. A. Fothergill on Lead.

† For cases of saturnine diseases vid. *Ligutand Hist. Anat. Med.* vol. ii. p. 22.

The symptoms of lead are easily distinguishable from all the other poisons. The hard cord-like pulse has been remarked as particularly attending the lead-colic: it is not however one of the absolute and particular symptoms, which forms a criterion; in inflammatory affections, it generally occurs, and is more or less perceptible in all cases of mineral poison. The great characteristic mark which distinguishes this poison, is the repression of all the excretions, and the pains and spasms incident thereupon, which, as in the colic, may be seen to contract some of the abdominal viscera. The palsy produced by the chronic operation of lead is another. From lead, the muscular fibres are observed to be pale and flabby, and the strength of those muscles that support the extremities, seems peculiarly affected.* But it is unnecessary to give any other marks of discrimination; those who have once seen the lead-colic, will not mistake it, and the length of time both after the disease has commenced, till it terminates, and before its visible operation appears, will leave no doubt even to those who have not seen it, when they compare the symptoms with those of any of the other mineral poisons.

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p. 22. — *Hoffman de Metal. Mortif. tom. vi. — Morgagni de sed. & caus. lix. p. 375. — Boerhaave, cent. iv. obs. 3. — Warren in Med. Trans. &c.*

* *Falconer Mem. Med. London Soc. vol. ii. p. 224.*

It is a doubt whether lead applied externally, be equally deleterious as when swallowed. *Baker* asserts that cerusse applied to the excoriated parts of infants, affected them with convulsions; and that litharge externally applied, produced colic.* On the other hand, *Haygarth* informs us, that out of fifty-three patients, who were blown up by gunpowder, and whose burns and contusions were very plentifully and frequently washed with the saturnine water, not one had the slightest symptom of colic or palsy, during the whole time of their recovery, though so many *nerves* were exposed to the immediate contact of lead.† The miners employed in extracting the lead-ore from the bowels of the earth, are not more unhealthy than other persons employed under-ground. But whatever may be the fact with respect to the application of lead in substance or in solution to the external parts of the body, the same by no means holds good with respect to the fumes. The workmen who extract the lead from its ore, and who are consequently exposed to its fumes, are liable to all the distressing symptoms of the internal use of this metal, which in some parts of England they call the belland.‡ This disease, which has been observed by many

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authors,

* *Baker* in London Medical Transactions.

† *Haygarth's* Letter to *Percival*.

‡ *Percival* on Lead, p. 112, 117.

authors,* is exactly the same as from the internal use of lead, and affects other animals as well as man; and as the metal by this mode of application, may certainly get into the stomach, it in some degree supports the opinion of those who think it always acts upon the bowels, and unless applied immediately to them, that no harm will ensue. Of this, I confess I entertain some doubt; and yet the fact related by Dr. *Haygarth* is so strong, as to hold the mind in suspense, between it, and an opinion which seems well founded, by the observations of *Baker* and *Percival*, and which is supported by the analogy of all the foregoing metallic poisons.

Lead may be taken in the quantity of three or four grains once or twice without injury, in any form; but if this dose be repeated for any considerable time, its effects will be gradually treasured up, till the tone of the intestines is nearly abstracted, when they will appear in all their malignity. A very large dose of lead is capable of producing this effect in a few hours, but owing to the irritability of the stomach, a quantity capable of producing it will seldom be retained long enough. On this account we very rarely hear of immediate bad consequences

* *Vapores Plumbi Freybergæ, homines metallarios precipue enecant, ideo 17 annis uxores ducunt, & 30 vix superant.* — *Haller El. Phys.* tom. viii. p. 103, in Addend. in *Plenck de Venenis*, p. 317. — *Mangeti Bibl. Med. Pract.* tom. iv, c. 18. p. 837. — *Hoffman de Metal. mortif.* in *Op.* tom. vi.

sequences from this poison. There is a wonderful difference either arising from original conformation, or from habit, in the power of different constitutions in resisting the effects of lead. Some persons are capable of bearing prodigious quantities, whilst others are affected with colic and palsy.

In cyder countries it was formerly not very unusual to mend their troughs and vats with lead. The consequence was, that the cyder became impregnated with lead, and great numbers of persons who drank the poisoned liquor, were affected with colic. But in families it was surprising to see the variety in time and manner, in which different persons, who drank nearly the same quantity of cyder, were affected. Some fell ill in a few days, and were soon cured, others resisted the poison for some weeks, but these persons were in general the greatest sufferers.

“ A girl took eighteen grains of acetated lead, every day for three weeks,* without the smallest inconvenience.”

A weak man, forty years old, took the following liniment at four doses, in the course of forty-eight hours. — Liniment. volatil. ziss . Camphoræ sacchari Saturni singulorum zi . — He had no sick-

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* Acta R. Soc. Med. Havniensis, vol. III. 1792.

ness or pain after it, but great giddiness and confusion of the head, with heat in the stomach and over the whole body.

At Salford, in Warwickshire, a person swallowed near a bottle of *Goulard's* extract of lead, without any inconvenience.

But though we may sometimes be so happy as to meet with persons who have escaped from the dangers of this poison, we ought rather to hope, than to expect, that we shall meet with them frequently: for in far the greater number of cases, injury would have been sustained, by either of the doses which are related above to have been taken with impunity. In the first case, more than a drachm of the oxide was taken daily, and on the twelfth day the pains began. In the second, a delicate woman was attacked on the fifteenth day, after she had taken fifteen grains of acetated lead every day, till that time, being in the whole 150 grains. In the one constitution, more than 720 grains had only the same effect in twelve days, as 150 had on the other in ten. But in much smaller quantities than either of these, I believe it is capable of producing its worst effects; as I am told by a physician of great experience,* that the pains have come on in cases

* Dr. *Johnstone*, of Worcester, to whom I am indebted for two of the foregoing cases of the effects of lead.

cases under his observation, from doses of three or four grains of the acetated lead, daily, continued only a week.

I cannot say much on the degrees of virulence of the different preparations of lead. If we may reason from the action of the metal and its oxides when taken into the stomach, it is to be inferred that they are all noxious, without any great difference of degree: and lead is one of those metals, which is so easily dissolved by the weakest acids, that wherever it is exposed in the preparation of our food, there is danger of its being taken into the stomach.

The presence of lead in solution is discoverable by liver of sulphur, when there is no calcareous earth dissolved along with it. — *Bergman* recommends the following test for the discovery of lead, in all circumstances. “ Boil a certain quantity of orpiment in water, and add double the quantity of quick-lime. The clear liquor will precipitate lead of a brownish colour.” — But *M. Fourcroy*, in his memoir on this subject, has shewn the uncertainty of all these precipitants, and recommends in their stead, water impregnated with hepatic air, which discovers lead in the most minute portions: a very brown cloud (*brun-noiratre*) being apparent, if 000,10 of the tartarite of lead, or indeed any other

of its neutral salts, be dissolved in the liquor.* This precipitant is particularly useful to detect the villainy of those who are induced by their avarice to poison our wine and our oil with lead, in order to correct the acidity of the one, and the rancidity of the other.†

On the time in which the preparations of lead will produce their effects, there is such a variety of opinion, founded on so great and complicated a variety of observation, that I can speak but with little confidence.

I have never seen any immediate apparent operation from the use of lead in man: on animals, in a very large dose, it produces sickness immediately, with very great uneasiness, convulsions, and death in the space of two days. This fact I have seen exemplified on a cat. In *Sproegel's* experiments, the sickness was immediate, and convulsions acceded in a few hours, from lead. — In the case

* *Mem. de l'Acad. R. des Sciences*, 1787, p. 288.

† The custom of rendering four wines sweet, by lead, is too notorious ever to be denied, and is taught in cookery books, with many other choice receipts for poisoning pickles with copper, in order that their green colour may be more beautiful.

“ In Holland it has been customary to correct the more offensive expressed oils, so as to substitute them for oil of olives and almonds, by impregnating them with lead.” — *Vid. Fothergill's Cautions on the poison of Lead.*

case of the ducks and geese, related by *Percival*, the animals all died during one night; and he relates some others, in which the effects were produced as soon, on smaller birds. — But in the human body, the operation is by no means, for the most part, so quick in its appearance. When the dose is very large, and not discharged by vomiting, the symptoms will undoubtedly appear in the course of eight or ten hours; and we know, without any resort to analogy, that from smaller doses, repeated, they have often appeared in their worst degree in the space of a week, and terminated in three or four days.

I shall avoid any thing that may lead to a discussion concerning the sedative power of Lead, a power which has been so warmly supported, and which has been supposed almost appropriately its own. The painful and obvious action of this poison on the alimentary canal, seems to afford us a better clue to its operation, than a discussion of terms, to which no exact ideas have yet been attached. But there are other circumstances which seem to point out, that a great injury has been sustained by the system at large, independent of that visible one, which the receptacle of a poison always suffers.

From lead, the bowels are affected with pain and
spasms,

spasms, the muscular fibres become pale and flabby, and palsy, or loss of voluntary motion of the muscles, succeeds—From arsenic, most excruciating pain of the stomach is soon followed by tremors, and loss of life; and after death, by sudden dissolution of the texture of the body. In the one case, there is a slow and silent abstraction of that power which constitutes life, and action is destroyed without much apparent solution of texture: whereas in the other it is quick, and the solution of texture is apparent—In both cases I have hinted before, that the effect is the same, though the cause producing it, varies the appearance of its abstraction in many different ways, and in many different periods, from circumstances in the construction of animal bodies, and in that of poisons with which we are not acquainted.

From all poisons, the action commences on the alimentary canal when they are first applied to it, and from thence is communicated to the rest of the body. From lead, the case is not different; the want of action of the intestines gives the first alarm of danger, the nerves being stimulated by the congestion of aliment, or perhaps by some peculiar state of the fibres surrounding them, to violent pain, the rest of the symptoms accede in course. Dr. *Haygarth's* cases are decisive in proving that lead does not act solely on the nerves.

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The cure of those poisoned by lead, must be undertaken with the intention of discharging the poison, or of correcting its virulent symptoms.

The first indication can never be so successfully pursued when the poison has been taken for several days, as when it has been lately swallowed; in no circumstances, however, should we lose sight of the intention of discharging it. For though it be taken in small quantity for a length of time, we are not to trust to its being expelled along with the other ingesta. Most probably some part will be collected in the intestines, while the rest is silently exerting its baneful influence on the constitution. In all cases, therefore, but more particularly when it has been taken in any large quantity, the first attempt should be to discharge the poison. For this purpose, emetic tartar dissolved in water, and administered by degrees, seems admirably adapted, as its operation most probably will not be confined. If, however, it should not act by opening the body, some brisk cathartic must be employed till this effect is produced. With aloes or calomel, scammony, the extractum colocynthis compos. of the London Pharmacopeia, castor oil should be generally employed in considerable doses for this purpose, and sometimes even it may be necessary to have recourse to the fumes of tobacco: but the choice of the particular cathartic must be always left

left to the judgment of the practitioner. Where the milder ones will succeed, it is useless, and even dangerous, to employ those that are so violent in their operation, as the preparations of tobacco; but when the bowels have lost much of their irritability, the most violent stimulations are often necessary to excite them into action. These stimulating medicaments may be given in glysters, as well as by the mouth, and very simple and mild means will often have the effect of opening the body, when administered in this form, though strong and active cathartics were previously administered by the mouth in vain. Often likewise, when the fæces have been long collecting in the intestines, their hardness contributes to costiveness; this state may be easily remedied by the copious use of diluents, which divide the hardened excrements, and lubricate the passage. In all these cases, oils ought to be given plentifully, and indeed their advantages are so many and so great, that no slight objection should be suffered to weigh against them. The diet should consist principally of broths, jellies, &c. which can hardly be taken in too large a quantity, unless the body is so obstinately costive, as to render their accumulation in the intestines incommodious. If by discharging the poison, its painful and deleterious consequences are not removed, we must have recourse to the second intention of cure. But before we attempt to relieve pain, or to subdue
paralytic

paralytic affections, it must always be remembered, that no hope of benefit can be entertained, till the motions of the bowels are in some degree regulated. All the opiates and tonics we can administer, will rather prove injurious, or of little avail, till this is accomplished. But when it has been accomplished, if the pain and spasmodic affections continue, then may opiates be administered both in mucilaginous draughts and glysters, and in considerable quantity: for the intestines, and indeed the whole body, become insensible to the smaller stimuli after a long use of the poison of lead.

From the first, the application of warm water will be found serviceable in alleviating the painful spasms; and through the whole course of the disease, warm baths impregnated with sulphur and mineral alkali, will be useful in correcting the effects of the poison. For the relief of the paralytic affections, and for the restoration of the tone of the system, many remedies are proposed by authors.—Dr. *Percival* recommends alum as a tonic peculiarly adapted to saturnine diseases. Of this remedy I cannot speak from my own experience, though I think it well deserves notice. In general, the cure of these affections is successfully pursued by the employment of electricity, and the aromatic stimulants, but sometimes we find all our efforts vain;
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tone is too much abstracted to be restored, and the patient at last sinks under an universal defect of bodily action. In such cases, no other general direction of cure can be given, than that in the choice of remedies the stimuli be applicable to the constitution and the strength of the patient.

IT would have been vain to attempt comprising every thing that is known or has been written on the several metallic poisons and their cure, within the narrow limits of an Essay. Each of them considered to its full extent would fill a volume. I have only therefore endeavoured to draw such a sketch, as shall be sufficient to mark one from the other, and to direct even those who are unacquainted with the properties and the powers of medicaments, what may be immediately done in cases of suspected poison, till a medical practitioner can be called. In this view, what I have written cannot be destitute of utility, and on this account I have rested upon some, as they may at first sight appear, trifling topics. In discriminating the poisons from each other, I have been more diffuse; and I hope have given such distinctive marks of the mode of operation, and of the appearances of each,

each, as shall leave as little room for mistake as possible. Not that it is possible, to comprehend all the varieties of complication within any one set of definitions or descriptions.

I have before given my reasons for not including zinc and bismuth in the number of mineral poisons. Dr. Cullen* quotes *Hellet* as giving instances of the deleterious powers of zinc; but as I have not been able to procure *M. Hellet's* work, it is impossible for me to know upon what data the opinion is founded. Thus far I know from my own experience: that eighty grains of vitriolated zinc taken at one time, and that ten grains of the flowers of zinc taken three times a day for more than three weeks, were innoxious in the first case to a woman of twenty-three, and in the latter to a boy about fourteen years old: nevertheless, we ought always to be cautious, where our knowledge is not precise.

Were all the active medicines to be ranked among the poisons, our definition of those deleterious powers would be confined to stimulant action, which I fancy no one will allow to be the case.

Bismuth

* *Matr. Med.* vol. ii. p. 30. — The learned Professor seems to have great objection to vitriolated zinc as an emetic, on account of the long continuance of its operation. For this reason, it is the most proper emetic that can be given in cases of poison.

Bismuth is in such common use as a paint, that its poisonous qualities must long ago have been discovered, were they powerful.

Of the other semi-metals, Manganese has lately become an object of much curiosity, from the abundance of oxygene which is procured from its oxides. I am informed by good authority, that when given to dogs it does them no harm, but on the contrary, makes them more lively.

An elderly fat man, took by my direction, $\frac{3}{8}$ s. of a black oxide of manganese, in the course of a week, without the smallest pain, or perceptible injury.

On this subject I shall beg leave to submit a case to the decision of the medical reader.

In May, 1794, I was desired to see *John Groves*,* æt. thirty, who had been affected four months before with grievous pain of his bowels, obstinate costiveness, dysury, and loss of voluntary motion of the lower extremities. His employment, previous to his illness, was bleaching rags, to make paper, at which he worked more than a year. From the first, he was disagreeably affected by the dust of the manganese, which was very offensive to his throat, and by the fume which arose from the mixture of this mineral with vitriolic acid and common

* Since dead.

common salt. He took by my direction the following pills, with an infusion of mustard seed; and a blister was applied to the lower part of the back.

R. Pil. hydrarg. conserv. ari, singulorum drachmam. M. & div. in pil. xxiv. [quarum sum. ii. mane & vesp.

The warm bath and electricity were also recommended, with a cordial diet, but I believe from the inconveniency of his situation, not applied. The pills kept his body open for ten days, when they lost their effect. As he lived more than twenty miles from Worcester, I had no opportunity of seeing him again, but recommended him to the Infirmary in that city, where he was brought in September following, in much the same state I saw him in May. The paralytic symptoms, costiveness, and dysury, continued as great as ever. He was discharged in November, not relieved, after taking necessary purges, with proper stimulants, under the direction of Dr. *Cameron*: blisters also were applied, and various other remedies, but in vain.

He was a very healthy man before his seizure, and unlikely to have any paralytic affection. At first I suspected that lead might have occasioned

his complaints, as the attack seemed remarkably similar to that of the lead colic; but I found, that lead could not possibly have occasioned them, unless the manganese was impregnated with it. I have learned since, that the poor man's wife being ill, he was not undressed for a whole month, during which time he often lay upon a stone floor near a fire. Immediately after this he had a violent attack of rheumatism, and soon after was affected with the pain in his bowels, and palsy of the lower extremities. None of the other workmen employed in the same business, have been affected: and the master of the paper manufactory has provided against any future bad consequences, by a contrivance for mixing the manganese, vitriolic acid, and salt, without exposing the workman to the dust or the fumes, arising from the mixture.

Whether the obstinate and terrible disease of *Groves* was occasioned by his employment, is at least doubtful, when all the circumstances of his case are considered. It cannot however be unprofitable to ascertain facts of such importance as those which relate to the health of manufacturers, and to provide by every means in our power against the suspicion of mischief: particularly with respect to manganese, which is likely to be employed so largely in the present state of medicine, we cannot

not be too anxious in collecting every fact, which has the smallest tendency to elucidate its properties.

I shall now proceed to give an account of the Earthy and Saline Poisons.

II.

EARTHY POISONS.

1. L I M E.

WHEN calcareous earth is deprived of its carbonic acid, by the action of fire, it becomes caustic, and forms the substance so well known by the name of quick-lime. In the state in which it is generally met with, it is inert, and none of its compounds are in any degree so active, as to render them deleterious. The poisonous action of lime, therefore, depends upon its mechanical caustic qualities.

“ The son of the surgeon *Hioseppus*, a boy of
 “ eight years old, was accustomed to eat hair, and
 “ the rubbish of old walls. By chance he met
 “ with

* with some quick-lime, of which he eat so abundantly, that he immediately fell into a violent fever, with urgent thirst: he drank a good deal, but his thirst was never allayed: he complained of excruciating pain of the stomach and the throat, threw up every thing that was given him, and could not taste any thing. He died on the ninth day after the accident.*

The symptoms related here, are those of active inflammation of the mouth, throat, and stomach, such as may be inferred will generally occur in similar cases—Violent fever, with insatiable thirst, excruciating pain of the stomach, burning of the throat, and vomiting of every thing that is swallowed.

In a dog, lime also excited the discharges by urine and by stool.†

The quantity of quick-lime to produce these effects must be considerable. Carbonic acid enters so largely into the composition of every article of food and drink, that a small portion would be immediately rendered mild. I think we may fairly estimate, that at least half a drachm of quick-lime,

G g 3 will

* Amati Lustani Curat. Med. cent. v. cur. 91.—For another instance in which lime was fatal, vid. *Mageti Bibl. Med. Pract.* tom. iv. p. 851.

† Calx cani obtrusa, alvum & urinam movit, miserumque animal emaciat. —Schinz de Cace in *Haller El. Phys.* vi. p. 215.

will always find a sufficient quantity of carbonic acid in its passage to the stomach, to neutralise it; and its caustic unpleasant taste, will prevent any more considerable quantity from being heedlessly swallowed.

The symptoms of inflammation of the stomach from lime, will be different from the same affection produced by cold, in no respect, except that in the former case, the inflammation will extend to the mouth, fauces, throat, and whatever parts are touched by this caustic mineral. Unless the quantity of lime swallowed be very large, corrosion of the stomach will not take place, as there will be generally a sufficiency of fluid either present, or secreted from the stimulation of the poison, to prevent this effect. If however such a case be supposed as that, in which a larger quantity of lime is swallowed, than can be provided against, by all the efforts of nature, and all the fluid and carbonic acid present, accidentally in the stomach, corrosion will undoubtedly take place.

The appearances of the stomach after death from lime, will be those of inflammation, mortification, and possibly corrosion; these appearances will extend as far as the lime has reached, and may be seen wherever it has touched.

If

If quick-lime be found in the stomach, its common appearance and taste will be sufficient evidence. It may be known moreover by forming gypsum with sulphuric acid, and white turbid mixtures, in liquids, impregnated with carbonic acid.

The time in which the inflammation produced by quick-lime terminates, will of course be varied by age and constitution. The child above-mentioned died in nine days—Inflammations of the stomach have terminated fatally in eighteen hours, and they have continued for fourteen days.

The action of quick-lime is nearly the same as that of the other corrosives: by its stimulant power, it excites inflammation, and in sufficient quantity will destroy the texture of whatever parts it touches.

Externally applied, lime may certainly produce very troublesome and dangerous ulcerations, or even the destruction of an organ. It is unlikely however that the forbearance of any individual will be so great, as to suffer it to remain long enough upon any part to have this effect; and guilt will hardly employ a mean so clumsy for the perpetration of its diabolical purposes.

It will be so easy to correct the deleterious powers of quick-lime, that the intentions of cure must be directed to this end, rather than to the discharge of the poison. For this purpose all liquors impregnated with fixed air, and all mixtures that extricate it, may be poured into the stomach; such as bottled perry or porter, fresh beer, and the common saline effervescent mixtures. If none of these remedies are at hand, copious draughts of water, and gentle emetics, may be given. After a sufficiency of them hath been employed to neutralise the quick-lime, or to discharge it, the usual remedies of active inflammation should be resorted to, and vigorously persisted in, till all danger is past,

2. B A R Y T E S.

THE ponderous earth is usually found either vitriolated or aerated: but both the fulphuric and the carbonic acid can be expelled from it by the action of fire, and it then becomes caustic, similar, in many respects, to quick-lime.

Of barytes I have little knowledge: I have taken it in its aerated state, to the quantity of ten grains, without any inconvenience.

The compound of barytes with the muriatic acid, is said to be poisonous to animals—I have seen a delicate female take thirty drops of the saturated solution repeatedly in the course of a day, without even nausea. It will require therefore at least two or three drachms to do mischief.

Of the peculiar powers of barytes, I can say nothing. Much has been written on its value as a medicine, but it is now almost laid aside.

For the action of quick-barytes, I must refer to what has been already said on lime. The cure in
all

all respects will be the same, except that if aerated barytes be deleterious, there will be a greater necessity for the use of active emetics in this case.

Barytes may be distinguished from lime, by its gravity. It forms a deliquescent salt with acetic acid, whereas lime is converted into a crystallisable salt.

3. SILICIOUS EARTH.

IN the state in which it is usually found, silicious earth is no more hurtful, than any of the other common sorts of earths: but in combination, it forms a substance, which, from its hardness and sharpness, is capable of doing great mischief when taken into the bodies of animals. Fused with a quantity of fixed alkali, silicious earth is converted into glass. This substance, so essential to convenience, and subservient to luxury, when broken into small pieces, affords innumerable sharp points.

There are many cases on record, in which broken glass taken into the stomach, proved fatal. "We read in *Fabricius Hildanus*, that the king's guards having got drunk, broke their glasses with their teeth, and all perished from swallowing the pieces."* Many other instances are referred to in *M. Hevin's* memoir, which I shall not enumerate.

The

* *Hevin* Mem. sur les corps étrangers, dans l'œsophage, in *Mem. Ac. R. de Chir.* tom. ii. p. 393.

The action of glass is merely that of an irritating cutting substance, which will lacerate the stomach, or produce an inflammation of the least remediable kind, as it will be very difficult to get rid of the irritating matter. A very small quantity will be sufficient to produce these effects. If the pieces be of a large size, the œsophagus most probably will be lacerated, in their passage to the stomach; and this is a certain cause of death if the wound take place in the thorax. It is evident that the danger in all cases will greatly depend on the size of the pieces of glass swallowed. When finely powdered, there is much less danger than when the pieces are of such a size as not readily to be returned by vomiting.

Fatal as the effects of swallowing glass have been, there have not been wanting persons who made a profit of swallowing it, and sometimes without immediate injury to their health:* but there

* " Quid quero sentis de Vittrivoris. Ego hic in vicinia tres cognovi viros robustissimos, quorum duo adhuc vivunt & quidem satis commode: tertius vero ante annos duos ex phthisi obiit: hi vitra quamplurima veluti cum aviditate devorant. Jam cupio vir amplissime ex te scire, quomodo fragmenta illa, ventriculum & intestina partes exquisitissimo sensu præditas, sine mortis periculo pertransire potuerint. Habet quidem Manlius in suis collectaneis exempla aliquot de Vittrivoris, sed insolentiae ac stultitiae suae penas meritissimas morti perfolverunt. — De his vide tractatum, *Den Christlichen Schlafstunch*. — *Hildani Obs. Chir.* cent. iv. obs. 2. p. 211.

there are few exceptions to the general rule, for many who made the same attempt, have paid for their rashness with their lives.

The term of operation when glass has been swallowed, will depend upon the injury done to the œsophagus or stomach. If large blood-vessels are cut through, life may terminate in eight or ten hours: if inflammation supervenes, in eighteen hours, or it may continue for many days.

Flints and chrystals, if they are sharp, will have much the same effect as glass; in general, however, they are much more obtuse, and consequently much less dangerous.* Needles, pins, sharp pieces of swords, may have the same effects.

From the corrosives, all these mechanical irritants, may be discriminated by their not inflaming the fauces, even though the patient should conceal the real cause of his calamity. Neither will the pain they occasion, be attended with so much anxiety or debility.

The

" Nuper Veterator per patriam meam iter fecit, puerumque circumduxit, quem aiebat, mala fabula usus, in deserta insula, ab ipsa necessitate compulsus, lapides didicisse edere. Deglutiebat utque miser filices Sed inventum est, nebulonem infelici puero sub noctem, purgans medicamentum obtrussisse, ex quo multo cum dolore lapides decederent. *Haller El. Phys. tom. iv. p. 214.*

* Qui homines filices deglutierunt, magnos inde dolores, & languores pass. — *Haller El. Phys. tom. vi. p. 214. From Phil. Trans. No. 258.*

The cure must entirely depend upon the size of the pieces of glass swallowed. If they were large, went down with difficulty, and lacerated the passage, I should much fear, that mischief rather than good, would be done by the exhibition of active emetics; on the contrary, they may be given with advantage, if the pieces swallowed were of such a size as to render their expulsion probable. Oil always should be poured down in large quantities. In those cases in which the return of the pieces of glass is improbable, may not the fluoric acid be given with advantage? The whole catalogue of *Mithridates* will be here of little avail. All that is to be done, is to sheath the stomach, and discharge the offending matters as quietly as we can.

III.

SALINE POISONS.

I. MINERAL ALKALI.

THIS production is one of those, which Nature has bestowed with the most liberal hand. It is not only diffused through the waters of the ocean, and piled in immense masses on many regions of the earth, but also enters into the composition of many vegetables. In its common state, mineral alkali is an active medicine, and administered in large quantities may do mischief; but it is more particularly entitled to a place here, when pure, uncombined with the carbonic, or any other acid. In this state it is called caustic mineral alkali, and if taken into the stomach, will inflame it and

and the œsophagus through their whole extent, and finally corrode and destroy their texture.

The symptoms, and the appearances after death, are nearly the same, from all the corrosive poisons; as well as the duration of the symptoms. They all destroy life by producing the worst effects of inflammation, in the shortest time.

It will require a pretty considerable dose (perhaps eight or ten grains) of caustic alkali, to destroy texture, as a small one will be neutralised by the carbonic acid it meets with in the passage, or by the contents of the stomach itself. But although neither the œsophagus nor stomach can be corroded by a small quantity, yet may dangerous inflammation be excited even by the contact of such acrid substances; they are therefore much to be feared even in the most minute doses, and ought never to be administered internally, without great caution.

Both the caustic alkali alone, and in conjunction with lime, is frequently employed externally as a corrosive, to destroy fungous flesh, warts, &c. and may certainly be very injurious to health, or even destructive, when injudiciously or malignantly applied. In all cases, the injury done must depend upon the importance of the part corroded. By the external application of a caustic, sight may be destroyed,

destroyed, and even life, if the corrosion is suffered to extend to arteries and nerves.

Alkalies may be discriminated by the compounds they form with acids—If they are ever found caustic, a slight trial of their effects will leave no room for mistake; and in this state they will not effervesce with acids. They may be known likewise by turning syrup of violets green.

Alkalies form, with quick-lime, compounds little less corrosive than the pure alkali alone. All the bad consequences of the caustic alkali, will result from its combination with lime, if they are taken internally, or applied externally, in sufficient quantity.

The cure is clearly indicated in all these cases by chemical affinities. If we impregnate the caustic alkali with carbonic acid, we render it comparatively mild. The same purpose is answered by neutralising it by any other acid which may be at hand. Aerated water, or bottled perry, or any of this kind of liquors is excellent; even fresh small beer, or large quantities of water, will answer the intention, when the more powerful correctives are wanting. If inflammation has supervened, and we are confident that the alkali is rendered mild, it must be remedied, by the usual antiphlogistic plan.

The compounds of mineral alkali with acids, though active, are seldom so violent in their operation, as to produce dangerous consequences. That with the carbonic acid is the most active, and should always be discharged by an emetic, when taken in large quantity.

What has been said of the caustic mineral, is equally applicable to the caustic vegetable alkali. They are not to be distinguished either in appearance or effects, in their pure state, being only discriminable by the difference of their compounds.

2. SULPHURIC

2. SULPHURIC ACID.

WHAT I shall say of the corrosive powers of this acid, will be equally applicable to the other two. In their concentrated states, they are all corrosive to a very great degree; and as their qualities are nearly the same, they are scarcely to be distinguished one from another. Swallowed in an undiluted state, the sulphuric acid violently stimulates the fauces, œsophagus, and stomach, and if it remain sufficiently long, corrodes them. When, therefore, it is taken in sufficient quantity, and not instantly discharged, which from its stimulating nature it is likely to be, all the symptoms of inflammation will quickly accede, with excessive pain of the stomach, burning heat in the mouth and throat, thirst, sickness, vomiting often of blood, &c. These will terminate in mortification and death, unless they are speedily and judiciously relieved.

After death, the stomach will be found inflamed, mortified, and perhaps corroded,* as well as those other parts touched by the acid.

H h 2

The

* *Lienhard Hist. Anatom.—Med. tom. 1. p. 35.*

The time which sulphuric acid takes to produce its worst effects, will be varied by the quantity swallowed, the state of the stomach at the time, and the age and constitution of the patient. I believe that the sulphuric acid has never been supposed to possess any other deleterious qualities than those which are derived from its corrosive properties. From these violent stimulants, inflammation has never been known to terminate in less than eighteen hours. But when all the bad symptoms have been removed, I have known very painful affections of the stomach, with general disorder of the system, continue for some time; and in one case, where two ounces of sulphuric acid swallowed by mistake, were immediately discharged, a degree of encreased sensibility has ever since affected the patient, with disease of the liver and the stomach.

It is not easy to fix the precise quantity of sulphuric acid that will prove hurtful. One would think that the extremely acrid taste would always be a sufficient warning against swallowing much, yet has it been taken unintentionally to the quantity of two ounces. This dose may produce the worst consequences that can be produced by the sulphuric acid; and I believe down to the small quantity of a drachm in its concentrated state, it may prove very hurtful, unless there be so much fluid in the stomach as to dilute it, or unless it be instantly discharged.

The cure must be attempted in the first place by neutralising or diluting the acid, and then by discharging it. Alkali of any kind, or absorbent earths, will completely answer the first intention, if they are given in plentiful draughts of water: when they are not ready, the water should be given alone. In this, and indeed in all other cases of suspected poison, it is of the utmost consequence, that diluents of every kind should be used in abundance. In innumerable cases they may preserve life, in hardly one, can they injure health. They are simple, but sovereign remedies, which the bounty of providence has placed in every body's hands, without the power of abusing them.

3. NITRIC ACID.

THIS acid, in the state in which it is usually procured, is more corrosive than the sulphuric, and perhaps possesses some deleterious qualities not inherent in either of the other two mineral acids. It is not however in its pure concentrated form that the difference is observable, as nearly the same quantities of all of them will produce similar effects. In the form of gas, and in conjunction with alkalies, nitre assumes a character, which has not in all circumstances been accurately appreciated. But we know from experiment, that the gas injected under the skins of animals, produces deleterious effects, * which are not produced by many other kinds of air; and that the neutral salts of nitre, are injurious in much smaller quantity, than those of any other acid.

The pure acid of nitre produces nearly the same symptoms as have been enumerated under the preceding article. It will perhaps act in a shorter time, and in smaller quantity, than the sulphuric acid: but there are no data by which to estimate the difference, and I do not conceive, that of either will be so great as to deserve notice.

The

* Reddoe's Considerations, p. 21.

The compounds of nitre with alkalies, are all very stimulating, though not corrosive, and have occasioned death in no very considerable quantity. An ounce of the common nitre has been known to destroy life;* and although persons have escaped after taking two ounces,† yet it was with much risque. In the latter case, the man who took it, was immediately affected with violent pain of the stomach and bowels. In about half an hour he began to vomit, and he continued vomiting for two or three hours, when he threw up blood. He was bent forward, and could not rise without the greatest pain. An affection of the stomach and bowels continued a long time, after the urgent symptoms were relieved.

In the quantity of half an ounce, the effects of nitre are to be feared. In delicate constitutions it may produce inflammation,‡ which will be always the

* Pyl's Repertorium für die öffentliche, &c. sect. 3.

† Falconer in Mem. Med. Soc. London, vol. iii. p. 327. — For another case in which nitre was swallowed by mistake in large quantity, see Alexander's Experimental Essays, p. 107. note.

‡ Nitre is so commonly used, and in the general opinion of physicians with so much efficacy in all cases of active inflammation, that it may appear singular to say it produces the state which it is supposed to remedy, when administered in too large quantity. Of late, nitre has been much given in typhus, and if we credit the accounts, with benefit. What shall we say then of its action; and how can we account for its use in cases so
opposite?

the apparent operation, from this salt, with the symptoms described in the case above related.

In *Alexander's* experiments, (14, 15,) two drachms and a half of nitre produced very alarming effects, when taken immediately after solution in water: but the same quantity after the solution had stood some time, was entirely inoffensive.

The nitrous acid may be distinguished from the others, by forming cubic crystals with the mineral alkali; and by flying off in red acrid vapours, when exposed to heat.

The cure must be undertaken with the same intentions, as in the case of sulphuric acid. To neutralise nitric acid indeed, it will be better to use calcined magnesia, and the other absorbent earths, than the alkalies; but if the latter are ready, and the others are not, they should be employed, with large quantities of water, milk, oil, or any bland fluid. With them, ipecacuan should be given in most cases, and particularly when the common nitre has been taken, it may be trusted to, without any other addition than the diluents.

4. MURIATIC

opposite? However these questions may be answered, still it should be remembered, that some preparations of antimony, which are violently stimulating in large doses, are most beneficial in all diseases of active inflammation.

4. MURIATIC ACID.

IN the account of this acid, nothing can be added to what has been already said under the two former articles. In its action, the muriatic is probably most similar to the sulphuric acid, as its corrosive properties alone constitute its deleterious powers.

All the acids are corrosive in proportion to the quantity of oxygene united with them. The muriatic can be united to an over-proportion without much difficulty, and assumes such new properties from the union, as make it an useful article in many manufactures. Hence it is liable to abuse, and therefore should be guarded against with vigilance.

The symptoms will be nearly the same from the same quantity, and in the same time, as well as the effects, and the appearances after death, from the muriatic, and the other mineral acids.

The muriatic acid will be distinguishable from the other two, by the mildness of its compounds, and by forming common salt with mineral alkali.

The

The cure is the same, as of the sulphuric acid.

The compounds of the mineral acids with each other; are all corrosive. That of the nitric with the muriatic acid, is probably the most active. They will have the same operation, and must be remedied by the same means, as already described.

TO what class of poisons the AQUA TOFFANA of the Italians is to be referred, I know not, as happily I have had no opportunity of seeing it, or observing its effects. Some authors think that it consists of arsenic, dissolved in a large quantity of water;* and others, that it contains lead. Whatever its composition may be, it will be easily detected, both by its operation, and by chemical analysis, if it contain either of these poisons.

The PULVIS SUCCESSIONIS,† is said by *Plenck*‡ to consist of fugar of lead, and a small quantity of arsenic; and by *Hevin*,|| to be only powdered diamond.

* *Plenck* de Venenis, p. 335 From *Gmelin's Mineralische giste*, p. 131.

† For an account of the dreadful manner in which this poison was used by the Marquise de Brinvilliers, and her paramour *St. Croix*, who learnt the secret from an Italian, vide *Abrege des Causes celebres*, tom. i. p. 47.

‡ *Plenck* de Venenis, p. 336.

|| *Mem. Acad. R. de Chir.* tom. ii. p. 393.

mond. (Diamant pulverise.) The accuracy of modern chemistry would soon clear up this matter, should it ever be brought into dispute. Fortunately, our country has never been scourged by those direful and malignant passions, which give birth to new modes of torture and destruction. Crimes indeed are the offspring of every nation, excrescences of wants and infirmities, which will deform even the most perfect of human societies. But it is only under the direction of such monsters as a *Nero*, a *Caracalla*, or a *Borgia*, * that these diseases spread so widely, and take so deep root, as to affect the very vitals of society. When the son armed against his father, and the wife against her husband, are solicitous not about those means that shall gild life with comfort and satisfaction, but only about those, that may produce the greatest sum of misery, with the least possible chance of detecting its cause. At such a moment, and in such a society, was the aqua toffana discovered; and the invention

* *Nero* gave rewards to those who discovered poisons, and had persons instructed in the art of preparing them. *Suetonius*, lib. vi. — If the quantity of poison contained under the gem of a ring, really avenged the slaughters of Cannæ, the ancients must have known much more powerful ones than we are acquainted with.

Caracalla had vast quantities of poison by him at the time of his death, "that he might secretly destroy as many persons, in as many different ways as possible." *Dionis. Anton. Caracal.* 32.

History is full of the infamy of *Alexander Borgia*, the supreme pontiff, and his son *Cesar*. The son narrowly escaped from, and the father fell a victim to poison, which they had prepared for some cardinals.

invention and history of the pulvis successionis, affords an instance of depravity and barbarity, that must make us blush for our nature.

With us, the case is widely different. Instead of encreasing the catalogue of these deadly powers, we have converted many of them into the means of health; and although unable to prevent the evils necessarily arising from their injudicious or malignant use, yet have we mitigated, and in some measure counterbalanced them, by their application to the unavoidable calamities of our imperfect condition.

I have thus finished my sketch of the Mineral Poisons, a subject rendered interesting by the weakness and wickedness of mankind. From the vegetable poisons they are distinguishable by their action. All the mineral poisons corrode, stimulate, or inflame: the vegetables generally stupify, and leave no marks of inflammation. None of the minerals terminate life, till after a most excruciating operation of two or three hours at least; whereas some of the vegetables destroy in a few minutes. From the animal poisons, the distinction is as striking: for although in the plague the mouth and throat are frequently affected in a similar way, yet the local disease of the stomach is never present. The aerial poisons operate still more quickly than
either

either of the other classes; and their action on respiration is so peculiar, that it can never be mistaken.

When the opinion of a medical man is required on the cause of death, in cases of suspected poison, the body should be always submitted to examination; and that he may form a right judgment, the dissection should take place as soon as possible after death. There are instances on record, where the opinion of a physician was required nine days after death. In such cases it is impossible to give a decisive opinion; all must be uncertain. Putrefaction so much disfigures parts, that inflammations and gangrenes will *appear*, where they never before existed; the blood-vessels ruptured, the viscera corroded, the whole body melting away. If putrefaction has commenced, a judicious physician should refuse to persist in the examination: he ought boldly to declare, in spite of prejudice and ignorance, that no precise information can be gained by dissection, and that his perseverance would only open a door to outcry and delusion. On the contrary, such a man will generally be enabled to pronounce what was the cause of death, when the body was opened before any marks of putrefaction were visible.

With respect to judgment of poisons from their
symptoms

symptoms—I think in most cases of mineral poisons there will be sufficient ground for a general, and in some few, for a particular opinion. When violent pain of the stomach suddenly comes on, with heat of the throat, trembling, cold sweats, and faintness, they should be always suspected, and the diluent plan immediately pursued.

Against vague and unfounded charges of poisoning, no other instruction can be given, than those distinguishing characteristics of poisons I have before enumerated. By these I hope that prejudices will be rectified, and suspicions silenced; that to the incautious and misguided, they will afford a shield; but to the dark and malignant assassin, complete detection.



NOTE,

N O T E.

THE following account of the external application of arsenic in the most horrid way imaginable, is copied from *Comment. de rebus Lipsiæ*, 1793, tom. xxxv. p. 242.

“ Rusticus, prima uxore repentina morte defuncta, brevi post ancillæ suæ nupfit, post paucos annos aliam ancillam imprægnavit, hujusque a cognatis incitatus, uxori ter arsenicum præbuit, quæ tamen effectum ejus poto multo lacte fregit: sequenti anno, mane quodam post coitum a cognato ancillæ subministratum & ab hac farina mixtum in illius vaginam digito immisit arsenicum, unde ea mox ægrotavit & sequenti die occubuit. Hinc sceleratus cum ancilla ista conjugium iniit, infelix autem, ideoque eam simili modo tollere constituit; hæc vero necis prioris conscia, quum octava post coitum hora inopinato et perdurante horrore, frigore, et urente vaginæ dolore corripereetur, facinoris confessionem et auxilia a marito extorsit, verum irrita, morte nimirum, lacte licet interne et externe adhibito post vomitus fere continuos, et deliria, elapsis 28 ab applicatione veneni horis subsequuta. Sectio monstravit abdomen non tumidum, nullas in cute maculas, labia vulvæ magna paullum tumida et rubra,

bra, in vagina patula flaccida, pauca grana arsenici chrySTALLINI, os uteri sphacelatum & apertum, corpus ejus naturale, ventriculum fere sanum, duodenum inflammatum multaue bile perfusum pulmones lividos fere nigros, in utroque cordis ventriculo polypos, reliqua viscera sana, sanguinem in omnibus vasis fluidum & solutum. Quo certius judicium ferre posset collegium medicum cl. Abildgaard duas equas simili experimento subjecit; singulæ bolum in arsenici ʒss. cum melle usque ad os uteri intrudens, altera successive injectionibus multæ aquæ tepidæ, olei lini, solutionis saponis albi in aqua tandemque aquæ vegeto-mineralis restituta post biduum; altera sibi ipsi relicta quarto die mortua, cujus sub sectione, genitalia & vesica urinaria inflammata & sphacelata, plurimæ corporis partes inflammatae." &c.

Acta Reg. Soc. Med. Havniens, t. iii. p. 178.

Note on the diseases of Gilders.

"NEAR two years ago I was first disordered by my trade of button-gilding, from which I experienced the following symptoms. — First, I was attacked with a violent pain in my head, which at intervals has continued ever since. Upon this succeeded

succeeded a great dimness of my eyes, so as to render vision very imperfect and troublesome, and which now remains upon me as heretofore. Thirdly, followed a tremulous or convulsed motion throughout my arms, legs, and thighs, so as to render me incapable of walking with safety without an assistant. From these circumstances I am now unable to continue my business."

This is the unaided account of a gilder himself, who describes what he felt. It is an exact copy of a letter which he wrote to a physician, soliciting advice.

N O T E.

The following rules for deciding from the symptoms, whether a person be poisoned or not, are translated from Faselius, by Dr. Farr.

1. FROM comparing the symptoms that present themselves, with those which generally attend the taking of poisons.

2. From the sudden appearance of some symptoms, such as spasms, violent pains, great thirst, sickness, vomiting, fainting, cholic, the throwing

up some foreign matter, from the general contents of the stomach, and universal convulsion of the muscles.

3. From the health of the patient foregoing this attack, and his not having had any connection with a person labouring under any contagious or epidemic disease.

4. From the patient having committed no errors in diet, &c.

5. From an ugrateful odour and taste of what has been taken.

THE END.

ERRATA.

PAGE 6. Note — for *Veneu* read *Venen*. P. 7. l. 24 — exist — exists.
 P. 11. l. 3 *from the bottom* — Burgman — Bergman. P. 20. l. 6 — gas — acid. Ib. l. 16 — more — little less. P. 21. note — History — Hist. P. 22. l. 11. note — Mithridate and Theriac — Mithridates and Theriacs.
 P. 23. l. 7 — patient's — patient on his. P. 28. l. 7 — internal — external.
 P. 29. l. 5 *from the bottom* — circumstances — circumstances. Ib. l. 2 — have — leave. P. 32. l. 2 — Veneris — Venenis. P. 33. l. 7 — any — many. P. 35. *last line* — are — is.

